Office - Supreme Court, U.S.
FILED
JUN 8 1983
ALEXANDER L. STEVAS,
CLERK

NO. 82-1246

IN THE SUPREME COURT OF THE UNITED STATES

OCTOBER TERM, 1983

BOSE CORPORATION, Petitioner

v.

CONSUMERS UNION OF UNITED STATES, INC.,
Respondent

ON WRIT OF CERTIORARI TO THE
UNITED STATES COURT OF APPEALS
FOR THE FIRST CIRCUIT

JOINT APPENDIX

CHARLES HIEKEN
470 Totten Pond Road
Boston, Massachusetts
02154-1981
Tel.: (617)890-0110

Counsel for
Petitioner

MICHAEL N. POLLET
Marshall Beil
Karpatkin Pollet
Perlmutter & Beil
708 Third Avenue
New York, New York
10017
Tel.: (212)557-4700

Counsel for
Respondent

PETITION FOR CERTIORARI FILED JANUARY 20, 1983

CERTIORARI GRANTED APRIL 25, 1983

TABLE OF CONTENTS

Relevant docket entries, U.S.D.C. ... 2

Relevant docket entries, U.S.C.A. ... 6

Excerpts from Trial Transcript, U.S.D.C. 8

Testimony of:

Amar Bose 8

Arnold L. Seligson 82

Monte Florman 195

Alan Lefkow 222

David Marvin Green 260

Amar Bose (recalled) 334

Notation of Plaintiff's Exhibits 2, 7 and 10 338

Plaintiff's Exhibit 9 (excerpt) 339

Plaintiff's Exhibit 29 342

Plaintiff's Exhibit 35 343

Amended Final Judgment, U.S.D.C. 344

Judgment, U.S.C.A. 346

Notation of Opinions Below 347

UNITED STATES DISTRICT COURT

DISTRICT OF MASSACHUSETTS

Relevant Docket Entries

Filing or Order Date	
Feb. 23, 1971	Summons issued; Complaint filed.
June 14, 1972	Plaintiff's Amended Complaint filed.
Oct. 15, 1973	Plaintiff's Consolidated Complaint (Amended) filed.
March 1, 1974	Defendant's Answer to Consolidated Complaint (Amended) filed.
May 9, 1975	JULIAN, S.D.J. Memorandum and ORDER dismissing counterclaims, ENTERED.
Jan. 8, 1980	JULIAN, S.D.J. RULING ON DEFENDANT'S MOTION FOR SUMMARY JUDGMENT ENTERED, denying motion in its entirety.
Feb. 19, 1980	JULIAN, S.D.J. Case called for Trial; Pltf's Opening; Pltf's Pre-Trial Brief, filing; Pltf's Evidence.

Feb. 20, 1980	JULIAN S.D.J. Civil Trial continues, 2nd day; Evidence.
Feb. 21, 1980	JULIAN S.D.J. Civil Trial continues, 3rd day; Evidence.
Feb. 22, 1980	JULIAN S.D.J. Civil Trial continues, 4th day; Evidence.
Feb. 26, 1980	JULIAN, S.D.J. Civil Trial continues, 5th day; Evidence.
Feb. 27, 1980	JULIAN, S.D.J. Civil Trial continues, 6th day; Pltf rests; Deft's Motion for Judgment Arguments; Motion denied; Deft's Evidence; Deft's Trial Memorandum on Evidentiary Evidence filed.
Feb. 28, 1980	JULIAN, S.D.J. Civil Trial continues, 7th day; Evidence.
Feb. 29, 1980	JULIAN, S.D.J. Civil Trial continues, 8th day; Evidence.
Mar. 4, 1980	JULIAN, S.D.J. Civil Trial continues, 9th day; Transcript of Trial Days 2/19, 2/21 & 2/22 filed; Evidence.

Mar. 5, 1980	JULIAN, S.D.J. Civil Trial continues, 10th day; Evidence.
Mar. 6, 1980	JULIAN, S.D.J. Civil Trial continues, 11th day; Evidence.
Mar. 7, 1980	JULIAN, S.D.J. Civil Trial continues, 12th day.
Mar. 11, 1980	JULIAN, S.D.J. Civil Trial continues, 13th day. Evidence.
Mar. 25, 1980	JULIAN, S.D.J. Civil Trial continues, 14th day.
Mar. 26, 1980	JULIAN, S.D.J. Civil Trial continues, 15th day; Evidence.
Mar. 27, 1980	JULIAN, S.D.J. Civil Trial continues, 16th day; Evidence.
Mar. 28, 1980	JULIAN, S.D.J. Civil Trial continues, 17th day; Evidence.
Apr. 4, 1980	JULIAN, S.D.J. Civil Trial continues, 18th day; Evidence.
Apr. 8, 1980	JULIAN, S.D.J. Civil Trial continues, 19th day; Evidence.

Jan. 21, 1981	JULIAN, S.D.J. OPINION ENTERED
Jan. 26, 1981	JULIAN, S.D.J. JUDGMENT for the Defendant as to Counts I and II of the complaint ENTERED.
Feb. 11, 1981	Case transferred to Chief Judge Caffrey.
June 4, 1981	CAFFREY, CH.J. Case called for civil non-jury trial first day.
June 5, 1981	CAFFREY, CH.J. Case called for civil non-jury trial second day; Pltf's evidence.
June 8, 1981	CAFFREY, CH.J. Case called for civil non-jury trial third day; Deft's evidence; Deft rests. Case taken under advisement.
Dec. 30, 1981	CAFFREY, CH.J. OPINION and Final Judgment entered. "1. Judgment for plaintiff on count III of the complaint in the sum of $115,296 plus interest. 2. Judgment is entered for the defendant on counts I and II of the complaint."
Jan. 8, 1982	Pltf's motion to amend final judgment, Filed.

Feb. 8, 1982	CAFFREY, CH.J. Amended Final Judgment ENTERED. Judgment is entered for the pltf. on Count III of the complaint in the sum of $115,296.00 plus interest in the sum of $85,788.11, and costs in the sum of $9,821.53, or a total of $210,905.64. Judgment is entered for the deft. on Counts I and II of the complaint.
Feb. 25, 1982	Deft's Notice of Appeal FILED.

UNITED STATES COURT OF APPEALS

FOR THE FIRST CIRCUIT

Relevant Docket Entries

Mar. 10, 1982	Copy of notice of appeal and of district court docket entries, received and filed. Case docketed, notices mailed. (mn) Form sent to the Register of Copyrights in Washington, D.C. (mn)
Sept. 14, 1982	Heard by Davis, Campbell & Bownes, J.J. [1am]

Nov. 2, 1982	Judgment: The judgment of the district court is reversed. Opinion of the Court by Bownes, J., concurring opinion by Campbell, J. Notices mailed. [lam]
Nov. 12, 1982	Petition for Rehearing, received and filed. (mn)
Nov. 23, 1982	Order (Davis, Campbell & Bownes, J.J.) denying the petition for rehearing for reasons stated in said Order. Notices mailed. (cb)
Feb. 3, 1982	Petition for a writ of certiorari (Supreme Court No. 82-1246) filed January 20, 1983. (ar)
Apr. 28, 1982	Order of Supreme Court granting certiorari (#82-1246) April 25, 1983. (ar)

UNITED STATES DISTRICT COURT

DISTRICT OF MASSACHUSETTS

EXCERPTS FROM TRIAL TRANSCRIPT

(Title omitted in printing.)

* * *

[2-6] AMAR BOSE, Sworn

Direct Examination by Mr. Perry

Q. Tell us your full name, please?

A. Amar Bose.

Q. What is your home address? A. 17 Deer Run, Wayland.

Q. What is your occupation, sir?

A. I am a professor of electrical engineering at MIT; and I am chairman of the board and technical director and president of Bose Corporation.

Q. For the record, MIT is the Massachusetts Institute of Technology in Cambridge? [2-7] A. Yes.

Q. Where and on what date were you

born?

THE COURT: Excuse me. Am I to infer from the president and chairman of the board that you are the chief executive officer of the corporation?

THE WITNESS: Yes, your Honor.

Q. What is the date and place of your birth? A. November 2nd, 1929, Philadelphia.

Q. Where did you get your education prior to college?

A. My elementary and secondary education was in public school in Abington Township, a suburb of Philadelphia.

Q. What education have you had beyond the high school level?

A. The remaining education has been at MIT, bachelor degree, bachelor of science, master of science and doctor of science.

Q. In what years did you receive those degrees?

THE COURT: Hold it.

MR. PERRY: Yes, your Honor.

THE COURT: Are they all in the field of science?

THE WITNESS: Yes, all of them are in the field of science with a specialization in the [2-8] field of electrical engineering.

THE COURT: When were you appointed professor?

THE WITNESS: In 1956.

THE COURT: Were you appointed full professor at that time?

THE WITNESS: I started as an assistant profesor.

THE COURT: When did you become a full professor?

THE WITNESS: I believe, your Honor, that that was in 1971 or '72.

I'm sorry. Did you ask full or associate?

THE COURT: You said you were assistant professor in 1956. I skipped associate. You didn't mention that, so I thought you had a couple of promotions.

THE WITNESS: No, no. I became associate professor somewhere in 1971, '72; and full professor, I don't really recall, but about-- I am sorry, 1961 or '62 for associate and full maybe '66 or '67.

THE COURT: Yes. How old did you say you were?

THE WITNESS: Now?

THE COURT: Yes.

[2-9/10] THE WITNESS: I am 50.

THE COURT: Thank you.

Q. (By Mr. Perry) In what year did you receive your bachelors degree at MIT?

A. In 1952.

Q. In what year did you receive the masters degree? A. I received that simultaneously in 1952.

[2-11] Q What year did you receive your doctorate degree at MIT? A. I received that in 1956.

* * *

[2-13] Q. I take it you were appointed a member of the faculty at MIT immediately after receiving your doctorate degree, is that correct?

A. That's correct.

Q. And have you been a member of the MIT faculty continuously from 1956 to date?

A. Yes, although the first year that I was appointed, I was granted a leave of absence to accept a Fulbright Fellowship to teach abroad.

Q. Where did you teach during that year?

A. I taught in the Indian Statistical Institute in Calcutta, India, and the National Physical Laboratory in New Delhi, India.

Q. What has been the field or fields of your teaching as a MIT professor?

A. Electromagnetic field theory, statistical theory of communications, network theory, and acoustics.

Q. Could you tell his Honor what network theory is?

A. Network theory is the theory of electrical and electronic circuits, kinds of circuits that you would find in radios or amplifiers or control systems --

THE COURT: What do they call that?

THE WITNESS: We called it network theory.

Q. How long have you been teaching courses in acoustics at MIT? [2-14] A. Approximately 13 years, I believe, 1967 I

started, or '66.

Q. And you're still teaching acoustics courses at MIT? A. That's correct.

* * *

[2-19] Q. Dr. Bose, are you the author of any text books which are used in universities and colleges? A. Yes, I am.

Q. What?

A. I'm the author -- joint author with Professor Kenneth Stevens at MIT of the book "Introductory Network Theory." I think your question specifically asked "that are used." The book was published by Harper and Row in 1965, I believe, and it's now out of print so I can't say for sure it is being used anywhere at the moment.

Q. At one time, was it used in a number of colleges and universities?

A. Yes, here and abroad.

Q. Have you written any papers in the field of acoustics that have been published?

A. Yes, a paper for the Audio Engineering Society in 1968 and a paper for the MIT Technology Review, two papers, in 1973.

Q. Are you the named inventor on any issued patents? [2-20] A. Yes, I am.

Q. Approximately how many? A. I believe 12 U. S. patents.

THE COURT: Were any of them in the field of acoustics?

THE WITNESS: Yes, about half, your Honor.

Q. Do some of those relate to loud speakers? A. I believe most of them do, most of that half.

Q. Specifically, do you hold a patent or patents that relate to the Bose

901 loud speaker with which we're here concerned? A. Yes.

Q. What professional organizations do you belong to?

A. I belong to the Audio Engineering Society and I'm a fellow of the Institute of Electronics and Electrical Engineers.

Q. Commonly called I.E.E.E.? A. Yes.

Q. Do you belong to any engineering honorary societies? A. Yes.

Q. What ones? A. I believe, Eta Kappa Nu, Tau Beta Phi, Sigma Psi, I believe that's all.

Q. Dr. Bose, have you received any awards or honors for your teaching at MIT?

[2-21] A. Yes. In 1963 or '64, I received the Baker Memorial Award for the best teacher at MIT.

Q. I guess it's hard to top that.

But, are there any others?

A. Yes, I received the Western Electric Award of the American Society of Engineering Education. I believe that was also for outstanding teaching in the field of engineering and that was probably 1965.

Q. Have you held any special chair at MIT? A. Yes.

Q. What was that?

A. The Lebel Chair. Mr. Lebel was a man who did work in acoustics. In fact, I believe he had to do with the founding of the Audio Society. I'm not sure but he left money for a rotating chair at MIT and I was the first one who occupied that chair for two years.

Q. Dr. Bose, have you lectured in the field of acoustics at various colleges, universities or institutions?

A. Yes.

Q. Could you tell us some of them, not all but just give us an idea of some of the places?

A. Ones that I recall -- of course, MIT, Boston University, Johns Hopkins, Applied Research Laboratory of Johns Hopkins University, Applied Physics, APL, of Johns [2-22] Hopkins University. I know there are other -- well, excuse me, did you ask me just universities at this point?

Q. And professional organizations.

A. Yes. A number of presentations across the country, different chapters of the Audio Engineering Society. I lectured before the Institute of Electrical Engineers. That's IEE of Australia in Sydney before the Corresponding Society in New Delhi, India. I lectured at the University of Basel in Switzerland. That's what I can recall at the moment.

There were more I know.

* * *

[2-23] Q. (By Mr. Perry) If you put aside all modesty, Dr. Bose, would it be fair to say that you are generally recognized as one of the leading experts in the world on design and theory in loudspeakers?

A. I believe that is correct.

* * *

[2-27] Q. As a result of the becoming interested in loudspeakers when you bought one, did you embark on a program of research and evaluation in the loudspeaker area? A. I did.

Q. And how long did that last? A. Until the present.

Q. All right. Did you conduct research at MIT on loudspeakers after you returned from your Fulbright teaching job in Calcutta? A. Yes.

Q. And without going into all the details, would you give us a general picture of the scope of that work as it existed from 1957 until 1964?

A. From 1957 until approximately '59 or '60 it constituted primarily making measurements on products that were then available and trying to understand the issue of measurements versus perception. By 1959 we could show that many statements that were in textbooks were not, in fact -- [2-28] they were old and they were not any longer applicable to the design of speakers. And at that point the project -- up until that point the project was a nighttime project and weekend project. After that it became an official project at MIT in the sense that Dr. Wiesner, who is now president of MIT, authorized that we could have students, we could use funds in the research

laboratory of electronics and have faculty also work on the problem. And the problems then centered all about the relationship between the measurements and perception.

Q. That work continued at MIT until at least 1964?

A. Yes, it continued in force until about '67 -- well, maybe even '70; and then it diminished in its activities. And in fact those programs, many of them, are now being carried out at the company.

Q. All right. When was the Bose Corporation organized? A. In 19-- in the summer of 1964.

Q. Were you the founder of the company? A. Yes.

Q. And, of course, it was named after you? A. Yes.

Q. And you own today the majority of the stock? A. I own about 60 percent.

Q. What offices have you held in the corporation?

[2-29] A. I have held alternately the office of president, always the office of chairman, and the office of technical director. I was, in the early days, also acting as the marketing, you might say, director.

Q. You were in charge of sales as well as the research in the early years of the company?

A. Yes, we were not large enough to have other people at that time.

Q. Where did the company have its original place of business? A. In 17 Erie Drive, East Natick Industrial Park.

Q. In 1970 did it move to another location? A. Yes.

Q Where? A. One Strathmore Road, Natick Industrial Park.

Q. What is the present location of

the company? A. 100 Mountain Road, Framingham.

Q. When did you move to the Framingham location? A. In 1972, I believe.

Q. What has been the nature of the business conducted by the company in general?

A. Its primary business is the design and production of loudspeaker systems. Its business has included electronics research and development for the Army, [2-30] for the Air Force, for the Navy, Department of Transportation, Atomic Energy Commission, and NASA.

Q. Has it also manufactured some other audio components or equipment besides loudspeakers?

A. Yes, it has designed receivers, which it does not also fabricate. It has designed and fabricated power amplifiers,

both for home use and professional musicians; and mixers, which is a device that musicians use, and loudspeakers for use by professional musicians.

THE COURT: What is a mixer?

THE WITNESS: A mixer is, your Honor, an electronic device in which when you have more than one microphone, you pass these microphones through a panel and you can mix part of the sound from this one and part of the sound from the other one to go to one loudspeaker, for example.

Q. What was the first loudspeaker that the Bose Corporation sold? Did it have a number?

A. Yes, it did, a Model 2201.

Q. When was that on the market?

A. I believe, Mr. Perry, that came on the market in 1966.

Q. And how long did you continue to sell the 2201?

[2-31] A. For about 18 months to possibly as high as -- I think that is it, about 18 months.

Q. Was it replaced by another product, another loudspeaker?

A. Yes, yes.

Q. And that was the Bose 901 loudspeaker? A. Yes.

Q. And that went on the market when?

A. Either late 1967 or early 1968.

Q. Right around the turn of the year? A. Yes.

Q. And who designed the Bose 901? A. I did.

* * *

[2-47] Q. Dr. Bose, you have been engaged in the design of loudspeakers continuously since 1956, is it?

A. Yes.

[2-48] Q. In your experience, is there a general goal or desired result which

designers of loud speakers for home stereo systems try to achieve?

A. Yes.

Q. What is that goal?

A. I believe and I hope that all designers are striving to create a loud speaker which comes as close as it is possible to producing in your home the sensation that you would get if you were present at the live performance of the music.

Q. Was that your goal when you designed the Bose 901 loudspeaker? A. Yes.

* * *

[2-84] Q. By April, 1970, Dr. Bose, how many retail dealers did you have handling the 901?

A. I believe we had about 200.

THE COURT: By what year?

THE WITNESS: By April -- by 1970,

your Honor.

Q. Now, I don't want any detailed sales information [2-85] at this point, but generally what was the trend of your sales from the time you put the product on the market until April 12, 1970?

A. It was excellent. The sales were increasing, as I recall, by at least 50 percent, my recollection is now; about 50 percent per year.

Q. That is 150 percent of the prior year? A. Yes.

* * *

[2-95] Q. Now, directing your attention to the next sentence, which reads as follows: "Worse, individual instruments heard through the Bose system seemed to grow to gigantic [2-96] proportions and tended to wander about the room. For instance, a violin appeared to be ten feet wide and a piano stretched from wall

to wall." Dr. Bose, could a listener hearing music played through a Bose 901 loudspeaker system hear instruments which appeared to grow to gigantic proportions and wander about the room?

A. Absolutely not.

Q. Could that phenomenon be heard with any other type of loudspeaker? A. No.

Q. Is it scientifically possible for those phenomenon to actually exist? A. It is not.

* * *

[2-98] Q. (By Mr. Perry) Dr. Bose, would you now explain to the Court why it is scientifically impossible for a loudspeaker to cause instruments played through it to appear to be of enlarged proportions or to wander about the room? Would it be helpful to use the board again?

A. Yes, it would.

MR. PERRY: If I may, your Honor, I think I'll number these sheets and then if we want to refer back to any of them by numbers, we can do so.

THE COURT: Very well. I think that would be helpful.

MR. PERRY: I'm putting the numbers on in red in the corners. May the witness step down to the easel, your Honor?

THE COURT: Yes.

THE WITNESS: Again, the starting place--

THE COURT: Can counsel see this?

MR. BEIL: Yes, your Honor.

THE WITNESS: The starting place is the [2-99] live instrument which the loudspeaker is supposed to be reproducing. If we can understand what it does, then we are ready to understand

what the loudspeaker does. In fact, maybe it would be helpful -- let me make an outline of the steps one needs to arrive at that answer, as I see it. One is to talk about the live instrument, live instruments; that includes instruments also in the voice. That's a musical instrument as well. Two, to look at loudspeakers; and three, to finally look at a test for any theory which could be proposed that would suggest the instruments as reproduced through loudspeakers could in fact grow and wander. So let's start with number one. Actually, I think we've, in the course of discussion this morning, covered some material with respect to number one that we can call on. Upon second thought, upon looking at it, it looks like a complicated diagram. If necessary, I will draw it over. Let's see if I can just

recall the conclusions that we drew from this. The blue curve, which was a circle, was used to indicate that an instrument, in this [2-100] case, the violin, radiates sound equally in all directions at the low notes. If it's played in the center of a room, the radiation in this direction is the same in that direction or another direction. That was the blue curve. As you go up in frequency, the instrument becomes more directional. It radiates strongly, perhaps, for one note in this direction, more weakly in another direction. As you change notes on the scale, in fact the directions at which the instrument radiates may change. It may radiate strongly in this direction and weakly in the direction that it was formerly strong.

THE COURT: What is the reason for

that?

THE WITNESS: Basically, the sound is emanating from, as we said, the whole board of the instruments; and the different parts are not vibrating together. So what happens is, for example, if one part is vibrating differently from another, if you look in this direction, the waves that are launched might add; and in another direction, the waves that come from two parts of an instrument may cancel. Since that vibration pattern changes [2-101] with frequency, the directions which the waves add and cancel change also.

Q. If I may interrupt just for the record, you are referring now to Sheet Number 4 of the drawings on the easel, right?

A. Yes, I am. Now, let's consider the other essential part to any kind of

music system, be it live music or reproduced music. That's the human being, the observer. Let's consider now we take this violin and begin by listening to it outside.

THE COURT: What do you mean, outside?

THE WITNESS: Outdoors. Just imagine for a moment that the violinist is playing here, and he's outdoors and we are listening some distance from him. All the sound that we get outdoors from him is what we call direct sound because it comes from the instrument to him, other than the earth, which isn't that good of a reflector. The assumption is it's outside, not in the city, in the open air. So there are no other paths that the sound could go through and come to the observer. So the angle -- that's what your ear is sensitive -- your ear

can sense angles from which [2-102] sound comes to you. Unlike vision, it cannot tell what the width of something is unless you know distance, and the ear cannot tell you except by other associations from other senses. So all the sound is coming to you from -- let's take the whole violin -- from a very, very narrow angle; and that angle, of course, depends upon how far away you are from the instrument. Now, if I am closer to that instrument, the angles will be larger because the sound is coming from the same area. If I'm further away, the angle would be smaller. But of course never has anyone, to my knowledge, observed that the violin is larger when it's closer than when it is removed. Let's take this violinist and put him in the center of a band shell.

Q. You are going from Sheet 8 to

Sheet 9, right?

A. Such as we have here like on the Charles River. Again, he is standing here and the audience is somewhere out here in front of the shell. Now, the sound is arriving from that violinist in a totally different manner. The purpose of this shell is to behave with respect to sound in the same way that a headlamp in an [2-103] automobile behaves with respect to a filament.

THE COURT: It's a reflector?

THE WITNESS: It's a reflector. The headlamp, the filament sends out light in all directions, and it reflects and comes to you when you look at the headlamp illuminated. What you see primarily is light from one end to the other. The mathematics of sound reflection from a surface are the same as the mathematics of light from a mirror. In other words,

if you have a hard surface that reflects very well, the equations are the same. For example, in light we all know that the angle that the light is incident on the mirror is equal to the angle of the reflection. The same thing holds for acoustics, which is a much bigger thing than the headlamp, but it's doing the same function. Sound is coming sometimes from here, sometimes from here, sometimes from here, and some bit of it directly from the instrument, a very small portion compared to what is going out in all directions. Now, this observer, and I think almost everyone in the room must have had the experience of sitting, enjoying music in front of a band shell -- now, the angle from which the sounds are coming [2-104] to your ear is much larger than it would have been if the band shell were not there and you were

just perceiving sound from this very, very narrow angle. But again, no reviewer or concert reviewer or anyone, for that matter, that I'm aware of, has ever suggested remotely that the violinist is now 50 or 70 feet wide, which is the width across the front of the stage from which the music is coming to the ears of the listener. So that, of course, had been observed -- if a person were sitting here using the auditory senses, to him the instrument would not be 50 feet wide -- well, you couldn't tell width unless you know distance -- but he would have a larger angle. Remember from back here -- do I refer to these, your Honor, as exhibits or --

Q. I think if you call it Sheet 1, Sheet 2, whatever.

THE COURT: Call them charts.

THE WITNESS: From Chart 4, we

observed that at some frequencies the sound is strong in one direction and weak in another direction, stronger here, weaker here. So going back to our band shell, what happens is that some frequencies, some notes on the musical scale, the violin will [2-105] radiate very strongly in this direction and very little, perhaps, in this direction or the other directions. So most of the sound that the listener will get from that musical note is coming from over here. Another note on the scale may cause that situation to change and the maximum energy would be radiated in this direction, and to the listener it would come from that angle. Nobody, to my entire knowledge, has ever reported that, while sitting in front of a band shell, they perceived that the violinist wandered about either the shell or about

the environment in which the listener was. Now, we have gone from a small angle here of the same instrument to a larger angle. Now let's go to a still larger one. That's the one that we found -- I believe we talked about that this morning. Let me see. That we find in a concert hall. We mentioned that this is -- excuse me, please. This is Chart 5. We mentioned that in a concert hall, as a result of the energy that was going out in all directions, that, as a result of that, you get reflections from all sides, including [2-106] the rear; and if you measured how sound is incident upon the ears of a listener in a hall, you would find almost equal amounts coming from all directions. So for the violinist outside, we perceived a narrow angle of those sounds, for the violinist in the band shell, a wider angle; and now the

violinist in a concert hall, an angle that goes in circles completely. No one, to my knowledge, has ever reported that when they are in the concert hall, the violin has become so enormous that it's in circles. So what is happening here? What's happening is that the angles through which the sound wave arrives at your ears have nothing to do with one's perception of how wide the musical instrument was that launched those sounds. Let's take this same violinist and take him into one more environment. We will put him in a room, and I think many people have had occasion to experience things like this. Let's suppose he is playing here in an auditorium, and I am now here in another room as an observer, listener.

[2-107] A. And there are two doors to this auditorium. The violinist is some-

where in here. He may, in fact, be hidden from sight from either door. He may be sitting in some position here. And I have the opportunity to perceive him through the two doors. Let these doors be, for example, ten feet wide. Nobody has ever perceived, you have had this experience, that the violin itself is ten feet wide because the sound is coming to you from two areas now instead of one. And here is an example in which you may get no direct sound whatsoever. So, again, the angles through which the sound comes to you are independent of your perception of the musical instrument. No one has ever perceived that that man, that that violin was ten feet wide, the width between the two doors, for example, and no one would perceive that, in fact, that this violinist was wandering about the room in

which you were observing. Now, going back for just one second to the concert hall. We showed what happened when the violinist was here. If that same violinist were moved to the corner, for example, the spatial patterns of radiation out of the corner would be totally different than the ones that are here, [2-108] but he would still be recognized as a violin of the proportions that we have learned from our other acoustics, an auditorium, rather, and to be sure, even if he were in the corner radiating sound from another direction, another note might be radiated out directly in the direction of the listener. Nobody has ever perceived the violinist to either become ten feet wide or to wander about the concert hall as he is, in fact, playing.

Now, let's go to the second topic on

the list that we had, which was loudspeakers. I guess if I had to say what is the most important thing that I have learned in the years of working in speakers, it is that a loudspeaker is, in fact, a musical instrument. Now, at first that sounds strange and would have sounded strange to me if somebody had said that in 1956, but the more I worked with them, the more I realized that. Let's look at the similarities. A loudspeaker of any design radiates low frequencies equally in all directions. A loudspeaker of any design, except a perfectly spherical one becomes directional at high frequencies. It radiates [2-109] some frequencies more strongly in one direction than it does other frequencies. A loudspeaker of the design like the 901, for example, will radiate some frequencies strongly both

front and to the rear sides and low frequencies omnidirectional.

And what is the other fundamental similarity? I think even at a philosophical level that is important that we understand because basically once you realize the loudspeaker is in fact a musical instrument, then your attitude towards the design evaluation is very much, I think, altered. Namely, we spoke this morning that we could play Beethoven's Fifth Symphony if we moved our hands fast enough. Every musical instrument launches its sound by starting with a mechanical input that causes a vibration. You can think of a musical instrument as something in which I apply mechanical motion and I get out acoustic energy. A mechanical input, meaning -- applying to the violin -- going up and down the fingerboard with my left hand

and the bow with the right hand.

What is a loudspeaker? Well, in fact, if we go back early enough the first loudspeakers [2-110] fit that system very well. The Edison-type loudspeaker used the mechanical scratches on a rotating disc and the speaker caused the amplification and production of acoustic energy from mechanical energy. As our technology advanced, we developed the kind of loudspeaker about which we spoke this morning, which has electrical terminals here and produces acoustical energy out.

So this, let us say, is a present day loudspeaker, and this is an instrument. Now, actually the loudspeaker has been recognized in the last 15 years as an instrument by the people who compose for it, the people who compose synthesized music. There are organs that are

snythesized. And again, I might point out that the signal that goes into this loudspeaker has nothing to do with size at all. If you synthesize an organ, which you can do today perfectly, you can make the same electric signal from a little keyboard that you can from a giant organ. When the person listens to the output of any loudspeakers he cannot distinguish the sounds between the two. And clearly the keyboard occupied a very little space; the organ a very large space.

[2-111] So fundamentally the loudspeaker is a musical instrument and as such its object is to take an input and provide as well as possible the sound that you desire as its output. The design of that speaker, I believe, must and it has in the 901 try more and more to achieve the kind of spatial incidence

that one gets in a live performance when you are in fact in your living room; that is, you get more sound energy from wider and wider angles. So that is how this design that we spoke of this morning operates.

THE COURT: Would that be Sheet 11?

MR. PERRY: I will put the numbers on if I may.

THE WITNESS; So, this loudspeaker for musical instruments sits in the room and it radiates sound patterns that hopefully cause you to receive a larger angle of incidence than you would if you had a conventional loudspeaker in which you had a beam at high frequencies that might be pointed directly at you, which is not the situation that you receive in the concert hall.

Now, we are ready, I think, to address [2-112] the key issue of why it

is not possible. There is a very, very simple test that one can make for anybody who could actually, if anybody ever did, propose a theory that loudspeakers of any design could cause the instruments to be enlarged and could cause sound to wander about the room. And the test is very simple. The first thing you must see about the theory is study it in depth, in fact, and find out does it predict the same thing for live instruments. And if it doesn't predict that, I need not go into the theories because in fact the loudspeaker is doing the same kind of thing that live instruments do.

Well, second part, if it does after all the theory -- either does or does not predict this -- if it does not predict it, we have a serious problem and it cannot be valid because a speaker is a

musical instrument and it does the same thing as a musical instrument. If it does predict it, we have an incredible problem because then it also predicts things that we have ourselves never experienced and that are, in fact, contrary to our daily experiences.

To simply illustrate that, I think [2-113] instead of the violin we will just take a look at the human voice. It is amazing the commonality of all these sources. The fundamental pitch of a male voice is about 120 Hertz, 120 cycles per second, that pitch. Those low frequencies just like from any musical instrument, just like from any loudspeaker radiate omni directionally, again a circular pattern indicating direction.

The highest frequencies the human voice is capable of radiating occur by turbulent airflow caused by restrictions

either with the tongue, the lips or the teeth. These represent high frequencies which are generated by air flowing in the turbulent form. And those, like a loudspeaker, are directional, highly directional. When I speak, for example, to all of you in this room, each of you is getting a different proportion of the direct sound to reflected sound, a different ratio of reflected sound depending upon which way I am pointing. Your Honor is receiving maximum direct sound at the moment; and now Mr. Hieken, you are receiving the maximum direct sound. I can control that ratio of direct sound to reflected sound, that sound which goes first to [2-114] a surface and then to you very simply by turning my head. For example, if I may do that -- let me move that thing for a second. I am here at the moment now and

I am giving you maximum direct sound, directly at your Honor. If I, in fact, turn my head in this direction, the majority of the sound is going to you via one reflection.

Now, I think your Honor or anyone else in the courtroom cannot perceive that I myself have grown to be ten feet wide, nor can anyone perceive that I am, in fact, as I am speaking to you wandering about this courtroom. So again with the natural sounds that are emanated by musical instruments, the voice, the loudspeaker, which is an instrument, are such that these phenomenon do not happen. If any theory were presented to say that it does happen, that theory must be first checked to make sure that it predicts that it would happen to all its brothers, the voice and the musical instruments. And if it did, we would have a real

problem because that is contrary to our total experience. And that, your Honor, is why I say [2-115] it is not possible to make that observation as a result of a loudspeaker.

Q. Dr. Bose, is it possible to make a recording which when played through a stereo system will make an instrument appear to go back and forth between the two speakers?

A. Yes, it is. And again to understand this, let's go back to where it al begins and to where it all ends, musical instruments. Suppose now I had two violinists, one here and one beside him. And suppose they arranged to play the same composition; and suppose the first one on the left, which I will label as you look at it L and the one on the right, R. Now, we prearrange with these violinists and we are standing out here

in front of them. We prearrange that first the one called L will play louder and then a little while later he is simply decreasing the pressure on his bow and R, the violinist called R will increase his and play louder. To be sure, you will perceive the sound moving from the left to right. Now, when you have a stereo system and you make recordings, what happens is the [2-116] following thing: You have again a stage. I will use the bottom part of Graph Number 13 just to indicate quickly a stage here. This has nothing to do with the top part. You have microphones. Today it is more common to use just two microphones. It used to be many, many microphones, but you have two microphones here. Sometimes they are directional, pointing out in these directions; that is, they receive more energy from here to

the right microphone and more energy from there to the left. There are many configurations of these.

[2-117] THE WITNESS: (Continuing) Now, these two recorders are kept as separate channels in the recording process, and eventually they produce two tracks on a record; but in general, there is a process called mixing them in between, which your Honor asked me about this morning. And that is a box in here which you again produce two outputs, but now you may get the output that comes out here, the left side, L prime and right, R prime, may not be just the left channel and may not be just the right channel. They may mix some of these together to get whatever effects they wish. Eventually, the L prime and R prime are fed to two loudspeakers. I am drawing too low. It's going off the chart. They

go eventually to two loudspeakers. With a bit of bias, I'm drawing them as 901s. Well, what happens is, if this mixer, while the recording is being made, changes so that he puts most of the signal into here and very little into this loudspeaker, of course you will hear the left loudspeaker play. If he puts more into the right speaker in the recording mix and less into the left, if you were to change it, of course, that would be terrible practice in [2-118] recording, you could do it. He could cause the sound to move back and forth between the speakers. But of course he would cause that same effect on any loudspeaker, just as you would cause it in the real world with two violinists playing. It would be independent of the loudspeaker. Also, the only way it could move is back and forth is in the plane.

It could never move about the room. We know of no theory that could project my sound as if it were coming from the seat of Mr. Hieken. The sound would not wander about the room. But if you wished to make a trick recording or if you made a poor recording, you could move back and forth between two speakers. But it would so move on any speakers used.

THE COURT: Does that phenomenon occur sometimes when you are playing a stereo and the sound seems to go from one loudspeaker to the other?

THE WITNESS: In the early days, your Honor, when stereo was first developed in 1956 or 1957, to show its virtues, manufacturers and everyone involved used to make what they call ping pong effects, the ping pong ball going from here to there, locomotives that would come [2-119] through your living room from the

left and out the right side. All good recording techniques today try very much to minimize that, and it was not a factor; nor was it in '70. Excuse me.

Q. Go ahead.

A. Just one thing this diagram suggested to me that I should remark on. That is if you make a source, a musical instrument by itself which cannot cause the sounds to move, two of them cannot cause the sound to move unless you play the game of increasing the strength or decreasing it or one or the other. One is incapable of moving the sound about the room; two are impossible.

* * *

[2-124] Q. Could you tell us about how many times since you first developed the 901 loudspeaker you have listened to music played through a 901?

A. I own them in my home. Thousands

of times.

Q. Have you ever heard in all those thousands of times what sounded to you to be a widened or enlarged instrument or an instrument wandering about the room?

[2-125] A. I have not.

* * *

[2-141] Q. Dr. Bose, after the Consumer's Union article appeared in May, 1970, did you personally go out into the field and talk to dealers about the impact of the article in the marketplace?

A. I did.

Q. And how much of your time during the year following the appearance of the article did you spend on that activity?

A. Almost all of the time that I was not teaching.

Q. And over what geographical area did you travel --

[2-142] THE COURT: Let me ask this

question: How much of the time were you not teaching?

THE WITNESS: I was teaching at that time, your Honor, I believe Monday, Wednesday, and Friday, which left four days in the week to work on the other aspect.

THE COURT: All right.

Q. And did you sometimes or customarily spend the other four days trying to combat the effects of this article?

A. Oh, yes.

Q. And where did you travel to meet with dealers? A. From coast to coast.

Q. Coast to -- Literally from the Atlantic to the Pacific.

A. Literally.

Q. And did you visit -- well, about how many dealers did you visit? Do you have any idea now? A. No.

Q. When you visited dealers, did you talk to the sales staff about the effects of the article? A. Yes.

Q. Did you also talk to retail consumers, that is, people who were purchasers or potential purchasers of loud- [2-143] speaker equipment?

A. In the environment of the store, there are normally consumers; and whenever that was the case, I take advantage of speaking to them.

THE COURT: In the course of a week, approximately how many roughly would you speak to?

A. What I would often try to do, your Honor, is make a trip, for example, to New York or to a place that I could go and return in one day on a Tuesday or a Thursday; and the long trips I would take, if we had a day holiday from MIT, for example a Monday holiday, I could

leave on a Friday night and return on a Tuesday evening. In an area like in New York you could visit a number of stores. I could visit up to about maximum of three stores in a day when I was in an area. I have never added all this up.

THE COURT: How long a period of time did you do this?

A. The most critical period was from the time of the report through the following Christmas.

Q. That was from May of 1970 to December 25 of 1970?

A. Yes. It didn't exactly end, but that was the time that we felt was absolutely critical to overcome the [2-144] problem.

Q. All right. As a result of the visits you made to dealers, talking with dealers, talking with salesmen, talking with consumers, and observing, yourself,

personally, did you form an opinion as to which of the statements in the article had been most damaging to the Bose 901?

A. Yes.

Q. What was your opinion?

MR. BEIL: Your Honor, any such opinion really is a compilation of a lot of talking; that is, a lot of hearsay.

THE COURT: Perhaps it might be well -- "most damaging" calls for a conclusion, really, but perhaps with respect to what aspects of the criticism made by CU --what was the most frequent complaint made?

THE WITNESS: The enlarged and wandering instruments and the statement about gigantic power required.

THE COURT: Did they use those very words?

THE WITNESS: Yes, your Honor, those very words.

* * *

[2-147] Q. You had some communications with management personnel of the defendant in which you asked for a meeting to discuss the May 1970 article, did you not?

A. That's correct.

Q. And you had such a meeting on June 3 of 1970? A. That's correct.

Q. Where did the meeting take place?

A. At C. U. facility in Mt. Vernon.

Q. New York? A. Yes.

* * *

[2-156] Q. After you left the listening room where did you go?

A. We then assembled for the main purpose of the visit and that was the meeting, back in the -- back in the original building.

Q. Who was present during the meeting?

A. Well, we met at a long table and -- you want me to draw it?

Q. Just describe who was there?

A. All right. To my right -- the table was long in this direction. To my right was Frank Ferguson. To my left at the head of the table was Dr. Walker Sandbach. Across, I think, Mr. Seligson. Next to Mr. Seligson was Mr. Nagel, I believe his name was Karl. Next to Mr. Nagel was Dr. Colston Warne and at the head of the table at the other end was Mr. Monte Florman.

* * *

[2-161] Q. All right. Now, in the course of the meeting did you ask some questions about who had heard these supposedly enlarged instruments as described in the article?

A. Yes.

Q. And who responded to that? A.

Mr. Seligson.

Q. What did he say? A. Do you want my question or what?

Q. Yes, why don't you give us the conversation about that subject matter, if you will. I am trying to cut out some of the extraneous matter.

A. I asked the questions in a sequence on purpose. And one that I asked first was that if the entire panel [2-162] had heard those enlarged instruments and wandering instruments, to which the answer was yes. I asked did the instruments just move back and forth between the two speakers along the wall or did they actually move out into the room. And the answer was, oh, no, they moved out into the room. Then I asked how many members were in the panel because I had read the article that Mr. Seligson had written about the 12 panel

members.

* * *

[3-2] Q. Dr. Bose, at the end of the day yesterday, you were telling us about what happened at the meeting at Consumers Union's headquarters in Mt. Vernon, New York, June 3, 1970, and to put things back in perspective, you were telling about some questions you asked about the panel which allegedly heard the widened and wandering instruments. And you had said that you asked if the entire panel had heard the enlarged wandering instruments and the answer was: Yes, and you asked whether they moved back and forth between the two speakers or moved out into the room and the answer was: They moved out into the room. Then you asked how many members were in the panel. What reply did you receive to that question?

A. Mr. Seligson paused at that point and then looked [3-3] to his left to Mr. Nagel and replied "two," and then had a small discussion with Mr. Nagel as to whether a third person had passed by at the time they were doing this.

Q. What was said next about that subject matter, if anything?

A. I believe at that point I asked that, since the entire panel -- oh, no, I think the next question that I posed at that point had to do with the number two. I asked how is it that this so-called panel is only two in number when, in fact, your Stereo Review article of -- I believe February 1959 -- Oh, let's see, just a moment -- 1969 said that there were twelve people used in the panel and, in fact, a picture was shown. The answer from that did not come from Mr. Seligson. Mr. Florman responded to that and said

words to the effect, "We don't have to do what we say in any article. We can test in any way we want. I believe there was no more discussion of why they showed twelve in their article on how they test speakers and why only two happened to have listened into the 901. At that point, I asked if -- or I commented that if the entire panel, even if it were only the engineer and his supervisor, Mr. Nagel, had heard [3-4] this effect of the enlarged instruments and instruments wandering about the room, I'm sure that all the members in the room would like to hear that; and since they had indicated that they had the speakers, I requested that they set them up and give a demonstration of this. That was just dismissed. They refused to do that.

Q. I show you, Dr. Bose -- had you finished your answer?

A. I believe that I requested to hear them at another time also on that same day.

Q. You asked for a demonstration of the Bose 901s which they had tested?

A. That's correct. My recollection is that I asked for that at least twice, but I specifically recall having asked for it on this particular occasion. I also suggested that we make or submit the speakers to an independent panel in which CU could participate to see if any of the panel members could, in fact, witness enlarged instruments or instruments that wandered about the room; and Florman, I believe, was the one who responded to that, saying, "We don't" -- words to the effect "We don't have time or resources to get involved in any kind of panel tests."

Q. In response to any of your

requests for a demonstration of the widened and wandering instruments using the [3-5] 901 speakers, did they indicate a willingness to make such a demonstration?

A. No --

MR. BEIL: It's a leading question and has also been answered.

THE COURT: Ask him what was said?

Q. When you asked for the demonstrations of these phenomena which they claimed to have heard, what did they say?

A. They refused the demonstration. I don't remember the words.

THE COURT: Who did?

THE WITNESS: That was Mr. Florman.

THE COURT: What did he say? Do you remember the words?

THE WITNESS: No, I just said I don't, your Honor, remember the exact

words; but they said, "We can't do that," to the effect that "We won't do it." But the exact words he used there I don't recall.

THE COURT: How many times did you request this?

A. My recollection, your Honor, is twice. The timing of the one request is the one I just testified to. That one I remember. It was in the same context [3-6] that we just discussed. But I believe I asked for it at one other time during the day. The timing of that I don't recall. Also, when it was refused, I then asked, "Could I be given the records, the names of the records that you used to hear this phenomenon?" I requested that. I requested that of Mr. Seligson, and he promised me that he would arrange to get those names; and that never did take place.

* * *

[3-12] Q. Now, turning to another subject matter, I want to invite your attention to the time when you took the lunch break during that day and ask you to tell his Honor as best you can recall the discussions you had with the Consumers Union executives during the luncheon break.

A. Yes. As I testified yesterday, I had announced to them in arranging for the meeting that I wanted to make the visit for two reasons: One was to discuss the specific problems that I thought existed in the testing of loudspeakers, in particular the 901; and another was to make suggestions that I thought were appropriate to improve the quality of their magazine in general. Needless to say, when you have a session like --

Q. Well, I think you are getting a little off track. If I may, Doctor, just tell us what you said and what they said during the meeting.

A. Yes, all right. I brought up -- I used as an example the review that they had made on the Citroen automobile. And the minute I mentioned [3-13] the Citroen, Mr. Seligson and I believe Mr. Nagel, but certainly Mr. Seligson began making very complimentary statements about this car. And I believe it was he or possibly Nagel who had owned one and it had saved his life on a broadside collision because of safety factors built into the car. And they made some very complimentary statements about the automobile. And then I asked them, "Gentlemen, do you read your own publication because you took three pages to tear that machine apart." They said

-- well, those are the people who -- those are the people who write the automobile reports, that is not us. I then asked, "Do you feel an obligation to point out good things in products? For example, there is a phenomenal steering mechanism in that car which is a very big safety factor. Now, you didn't mention that. Did you feel that is a good thing to do? I think it is." And then I asked about the statement they made in that article which said that green blood oozed out all over. And I said, "Gentlemen, what happened? Did you have a brake leak?" And they said, "Yes." And then I said, "Look, can't you see that by making statements like that you [3-14] bias the reader not only against the product, but against the whole manufacturer. And don't you think your magazine would be more useful if you would just stick to

the facts?"

And at that point Mr. Florman, who was on my right side, said to me, "Dr. Bose, what do you think people read our magazine for?" I paused and I said, "Well, product knowledge, of course." And Walker Sandbach, who was on my left, pounded on the table and he said, "No, Dr. Bose, you are wrong. You are wrong, Dr. Bose. People read our magazine for entertainment."

THE COURT: Who said that?

THE WITNESS: Walker Sandbach, the executive director, who was on my left. And at this point Dr. Colston Warne said -- he hadn't said much, in fact, anything I guess during the whole meeting. He said, "Yes, yes, Dr. Bose, that is correct." He said, "We made a survey a couple of years ago and it showed that people really do read our magazine for

entertainment. It is not for product knowledge. They love to read about vermin hair in Campbell soup," which they had had an article on. And at this point Mr. Sandbach said, [3-15] "Dr. Bose, you are right. If we took out the sarcasm -- and he added the word spice -- "in our reports, it would be a more factual magazine." He said, "However, do you realize what would happen to circulation? It would drop to a quarter of its value."

Q. Who said that?

A. That was Mr. Sandbach.

THE COURT: How do you spell that name?

THE WITNESS: S-a-n-d-b-a-c-h, your Honor.

Q. Is that the substance of the discussion during the luncheon interval?

A. That is.

* * *

[3-27] Q. His Honor's question reminded me, did you at some point ask the defendant to publish corrective material in its magazine about your loudspeaker?

A. Yes, I did.

Q. When did you do that?

[3-28] A. I believe that was done in the response that Mr. Sandbach asked for at the end of the meeting, the response which I sent him within a week.

THE COURT: The first letter you wrote to him?

A. After the meeting, your Honor.

THE COURT: After the meeting?

THE COURT: That's correct.

Q. Did they ever at any time up to the present day, ever publish anything to correct or comment upon or explain what they had said about your 901 loudspeakers in the May 1970 issue of their magazine?

A. No.

* * *

[3-118]

CROSS EXAMINATION by Mr. Beil

* * *

You're, as you said, the owner and founder of the Bose Corporation?

A. Sixty per cent -- approximately 60 per cent owner and founder.

Q. Are shares of the corporation also owned by members of your family, your wife and children? A. Very small amount.

Q. In addition to the 60 per cent? A. About 1 per cent.

* * *

[5-49] Q. You testified earlier that you were adding dealers at this time. Did you ever lose a dealer because of what was published in the Consumer Reports article?

A. Not to my knowledge.

* * *

[5-118] Q. Did the Bose Corporation ever become first or second in the loudspeaker market in terms of either units or [5-119] dollars, depending on who is measuring what?

A. To the extent that I can believe the surveys, that is correct.

* * *

[5-122] THE WITNESS: Oh, I am sorry. The best of my present recollection is '78 or '79. I'm really not sure, within a year or so.

THE COURT: In dollar volume or in volume of sales units? Units or dollars?

THE WITNESS: Either one or the other. I am trying to remember what it said.

* * *

Redirect Examination by Mr. Perry

* * *

[5-125] Q. Defendant's Exhibit Z, which is in evidence, indicates that prior to May of 1970 your company had sold something over 9,000 pairs of Bose 901 speakers, as I recall. Let me ask you this: Has your company, to your knowledge, ever received a complaint from anybody who owned Bose 901 speakers other than the defendant in this case that the speakers caused instruments to appear to be of enlarged proportions or to wander about the room, ever have you received such a complaint from an owner?

[5-126] A. Never.

MR. BEIL: Objection, your Honor.

THE COURT: Well, strike out the answer to the extent that it was made. I didn't hear it. What is your objection?

MR. BEIL: Well, first of all, I think that it is going beyond the scope of cross-examination. Second of all --

THE COURT: I will overrule that objection.

MR. BEIL: Second of all, I think the witness is going to be read some statements about -- well, I will stand --

THE COURT: You are anticipating.

MR. BEIL: I stand overruled, your Honor.

THE COURT: The only objection you had was it was outside the scope of cross-examination?

MR. BEIL: That is correct, your Honor.

THE COURT: Overruled. Do you know the question?

THE WITNESS: Yes. I am sorry for answering early. The answer is no.

* * *

[6-111]

ARNOLD L. SELIGSON, Sworn

DIRECT EXAMINATION by Mr. Pollet

Q. Could you please state your name and occupation?

A. My name is Arnold Lawrence Seligson. And my occupation is that of electrical engineer, and I am presently the Chief of the Electronics Division at Consumers Union of the United States, Inc.

Q. Is that the defendant in this case? A. Yes.

Q. What is your business address, Mr. Seligson? A. My business address is at 256 Washington Street, Mt. Vernon, New York, 10550.

Q. And is that the principal headquarters of Consumers Union? A. Yes.

[6-112] Q. Would you give us your home

address, please? A. I reside at One Wendover Lane. That is spelled W-e-n-d-o-v-e-r, Suffern, spelled S-u-f-f-e-r-n, New York, 10190.

THE COURT: Where is that?

THE WITNESS: That is in Rockland County, New York, your Honor, approximately 35 miles northwest of New York City.

Q. How old are you, Mr. Seligson? A. I'm 49 years old.

Q. Are you a college graduate? A. Yes.

Q. Where did you attend college? A. I attended college at the City College in New York, that is now a division of the City University of New York.

Q. And is the City College commonly referred to as CCNY? A. Yes, it is so commonly referred to.

Q. Can you tell us the years that

you attended CCNY? A. Yes, I attended CCNY during the period from 1948 to 1952.

THE COURT: Did you get a degree or not?

THE WITNESS: Yes, your Honor.

THE COURT: What degree did you get?

[6-113] A. Bachelor of Electrical Engineering.

* * *

[6-114] Q. Mr. Seligson, have you continued your studies beyond the undergraduate level? A. Yes, I have.

Q. Can you tell us where you continued these studies and provide us with the time period, please?

A. Yes. I'm matriculated towards the degree of Master of Electrical Engineering at City College, and I attended City College during the period of time between 1953, roughly, and 1956.

Q. Did you receive a Masters Degree

from City College? A. No, I did not.

Q. Why did you not complete your studies for the Masters Degree?

A. Well, approximately during the latter part of 1956, I became engaged to be married and I found that since I was attending evening school, the demands on my time, based upon my new prospects of marriage as well [6-115] as the demands made upon me by my job, made it almost impossible for me to continue.

Q. Were you employed during this time period, during the mornings and afternoons? A. Yes, I was.

Q. Where were you employed? A. I was employed at the United States Naval Material Laboratory in Brooklyn, New York.

Q. Have you ever had any educational courses in the field of acoustics? A. Yes.

Q. When would that have been? A. That would have been approximately 1953.

Q. Do you recall the name of the educational institution?

A. Yes. The course was sponsored by the Brooklyn Polytech Institute in Brooklyn. I was a recruit of the Brooklyn Polytech Institute.

* * *

[6-116] Q. Following your graduation from CCNY, with a Bachelors Degree in Electronic Engineering in 1952, did you work as an engineer or as a scientist?

A. Yes.

Q. Can you tell us where you were so employed?

A. I was employed at the Naval Material Laboratory and my title at that Laboratory was that of Electronic Scientist with a specialty in electro acoustics.

Q. Is the Naval Material Laboratory maintained by the United States government?

A. Yes, it is. It is an arm of the Bureau of Ships of the Navy Department.

Q. And during what period of time were you employed at the Naval Material Laboratory?

A. Well, I was employed starting almost immediately upon my graduation from City College, and the employment lasted until the early part of 1956.

Q. Would you describe for the Court, please, Mr. Seligson, your duties and responsibilities as an electronic scientist at the United States Naval Material Lab?

A. Yes. My duties included such diverse functions as planning and executing tests upon a wide variety of electro acoustic equipment which was

employed by the [6-117] Navy on board ship and on shore installations. Such items as loudspeakers, microphones, intercom systems designed for on board ship; entertainment systems which were designed and intended for use on board ship for the benefit of the seamen. That included measurements and on the tape recorders, magnetic tape, and other such like devices.

Q. Did your work at the Naval Material Lab include evaluating or designing loudspeakers?

A. My work included largely -- largely consisted of evaluating loudspeakers; there was machine design work as well.

Q. Can you describe for the Court, please, the nature of your responsibilities in evaluating loudspeakers while you were at the United

States Naval Material Lab?

A. My responsibilities grew in scope indirectly in accordance with my employment. I started out as a Grade GS-5 and when I left, I was Grade GS-11, so that my responsibilities evolved as those positions changed. And they consisted in evaluating loudspeakers or such factors as the ability to reproduce sound properly, to meet certain specifications, with respect to durability and endurance. They involved making recommendations to the [6-118] Bureau of Ships for changes to be made in the loudspeakers or other items which we evaluated so that they would better meet the requirements of the Navy and of ship work use.

Q. Did you work on loudspeakers during this period -- strike that, please. Have you ever written any

articles on the subjects of electronics or home high fidelity equipment?

A. Yes.

Q. Can you describe these articles for us, please?

A. Yes, I wrote one article on a technical subject. Its title was the Free Field Techniques for Secondary Standard Calibration of Microphones. That article appeared in the journal of Audio Engineering Society. And I wrote a virtually monthly column for the New York Times. That column appeared sometimes every month, sometimes there was a gap of a month or two. The topic of that column dealt with home entertainment equipment, broadly defined as high fidelity equipment. And the column appeared in the Sunday entertainment section of the New York Times.

* * *

[6-151] Q. Mr. Seligson, during the course of your employment at Consumers Union, and prior to 1969, had you had any experience in testing, evaluating and measuring loudspeakers? A. Yes.

Q. Can you please describe for us what that experience was?

[6-152] A. There was experience which I had while working for the Navy, which I have already described. In addition, starting in 1958, Consumers Union performed a number of tests on loudspeakers, approximately four or five projects in the testing of loudspeakers. And during which time I believe we had tested as many as one hundred or more loudspeakers.

Q. And subsequent to May, 1970, from that point on to the present date, have you continued to have any experience at Consumers Union in the testing and

evaluation of loudspeakers?

A. Yes. Subsequent to that period of time, we performed perhaps half a dozen or so projects on loudspeakers, testing at least as many loudspeakers in that period of time as in the years prior to 1979 -- pardon me, to 1969.

Q. Can you tell us approximately how many articles were published in Consumers Reports, based upon tests conducted or supervised by you?

THE COURT: In what field?

MR. POLLET: In the field of loudspeakers, your Honor.

THE COURT: All right.

A. I would estimate -- I haven't taken a precise count. [6-153] I won't stipulate it would be a dozen or so or close to a dozen projects.

Q. Mr. Seligson, did you have any duties and responsibilities with respect

to the conducting or supervising tests and measurements and evaluations of loudspeakers in connection with the loudspeaker article appearing in the May, 1970 issue of Consumers Reports?

A. Yes.

Q. Can you describe for us, please, what those duties and responsibilities were?

A. Yes, as a senior project engineer at that time, it was my duty to plan the overall project. To plan the tests that were to be performed, to supervise others in the performance of those tests, and to perform some of the tests myself, to analyse the results which were yielded by the tests and to prepare or supervise the preparation of our report to the Editorial Department.

Q. I believe you testified that your duties included supervising other persons

who were -- had some role in the tests and evaluation of loudspeakers leading up to the May, 1970 article, is that correct?

A. Yes.

Q. Can you identify those people for us, please?

A. Yes. One of them was a Mr. Alan Lefkow. Another [6-154] individual was Mr. Lawrence Gianguzzi, I'll try to spell that for you: G-i-a-n-g-u-z-z-i. Another individual who participated on occasion was a Mr. Eric Maneskjold.

Q. What was Mr. Lefkow's title or position at Consumers Union during this time?

A. Mr. Lefkow at that time was a project engineer.

Q. And can you tell us in a general fashion what Mr. Lefkow's duties and responsibilities were with respect to the

Consumer Reports, May 1970 loudspeaker?

A. They were general engineering functions. He was expected to set up equipment, to perform tests, to be able to see to it that they were properly -- that the equipment was properly calibrated, functioning properly, that the tests were being properly done. He made measurements on the loudspeakers and he assisted in the preparation and analysis of the reports.

* * *

[7-21] Q. I believe that the last type of listening test which you referred to was demonstrated as special listening tests. Can you describe this test and give us the purposes of these tests?

A. To further evaluate the special sound characteristics which were claimed for some of the loudspeakers in the project. We set them up in the listening

room and two persons, myself and Mr. Alan Lefkow, listened for an extended period of time, using a number of records, to the three loudspeakers to see what we could hear in the natural course of listening, to see if we could discern what it was the loudspeakers [7-22] were intended to produce in the listening room.

Q. Mr. Seligson, you have described three listening tests with three separate sets of panelists. Why were three sets of panelists chosen?

A. Well, the panel of five was a strict requirement due to the eventual statistical analysis of results. And the panel of two for the cricket tests were simply two observers who were readily available at the time. It was only necessary that they possess the normal human faculties of being able to point to

the direction from which a sound comes. And finally, for the special test, I felt that this would require a subjective evaluation. I thought that the appropriate parties to do this were these very engineers who would be required to describe what they heard in writing.

* * *

[7-23] Q. And why were the panelists selected for the special listening tests?

A. The special listening test panelists, myself and Mr. Lefkow, were engineers with experience and a knowledge of acoustics and electronics; and we felt that they would be the appropriate parties to make those subjective judgments that were called upon by this test.

* * *

[7-96] Q. Turning back to the page [of PX9] headed "Personal Observations on

Bose 901," please, can you tell us where these tests, the special listening tests that you and Mr. Lefkow conducted, took place?

A. Yes, they took place in the Consumers Union's listening room.

Q. And do you recall how long the test took place?

A. The test took place for several hours. I cannot put an exact figure on it. It was at least two hours.

Q. Can you describe for us, please, how the test was conducted?

A. The test was conducted as an A-B test. Mr. Lefkow and myself were in the room listening [7-97] to the Bose 901 loudspeakers. We were able to switch back and forth to a reference loudspeaker, which was an ADC 301, I believe, and we played various records on a turntable and listened to the music as it sounded forth. As we listened to the

music, we noted whatever effects we heard; and we walked around the room, did quite a bit of listening, and then recorded the data in this notebook.

Q. Was the date that you did this test recorded in this notebook? A. Yes, it was.

* * *

[7-99] MR. POLLET: Perhaps the witness should read the whole portion that is in his hand, your Honor, so that it will be clear because it is in his handwriting, and it's not all that legible.

THE COURT: All right.

THE WITNESS: All right. It says: "Appears to have exaggerated mid bass, not particularly objectionable, but noticeable. Piano music is unusually spread. Piano is wall to wall. Violin is also widened (Menhuin-Shankar) and appreciable moves across room."

THE COURT: And appreciable what?

THE WITNESS: I believe that was meant to be appreciably. "Violin not as wide as piano. Seems effect is strongest on 'centered' sound. Try mono records." Beneath that is written: "Eureka!"

THE COURT: What did you find --

THE WITNESS: That which follows: "Mono is 'vastened' - all space noted for stereo, also noted for mono. Broadening effects also noted."

THE COURT: I don't understand the explanation, "seems effect strongest on centered sound." I don't see the pertinence of it.

[7-101] THE WITNESS: Ordinarily, I would have expected to find that mono records would have produced a tightly centered sound in the listening room, right between the two speakers. What I found, instead, was a wall of sound

across the room much like stereo records, and I was surprised at this; sufficiently to write down the word "Eureka," your Honor.

THE COURT: All right.

Q. When did you write the data? Was it while you were listening to the records or afterwards?

A. No, it is a summary written immediately after listening.

Q. Did you and Mr. Lefkow write your comments at the same time?

A. No, we wrote them one after the other.

Q. How long after you had completed your listening to the Bose 901?

A. Well, I couldn't say with certainty. It was certainly within minutes.

Q. Were any other speakers included in this test on this occasion?

A. We listened for a short period of time to the Harmon-Kardin KH 50s in a similar circumstance, [7-102] but we noted nothing particularly unusual about it and we stopped listening very quickly. The other loudspeaker that was listened to was the reference loudspeaker, which was there for a reference effect so we could see what ordinary loudspeakers that have their loudspeakers mounted on the front panel facing the room would sound like under the same circumstances.

Q. And was this test and the comments recorded the basis for the portion in the Consumer Reports loudspeaker article which referred to, "Individual instruments heard through the Bose system seem to grow to gigantic proportions and tended to wander about the room. For instance, a violin appeared to be ten feet wide, and a piano

stretched from wall to wall." Is that correct?

A. Yes.

Q. The Consumer Reports article goes on to say: "With orchestral music, such effects seemed inconsequential, but we think they might become annoying if listening to soloists." Can you give us the basis for those [7-103] last two sentences with respect to orchestral music and soloists?

A. Orchestral music is ordinarily expected to occupy a wide sound stage with a substantial spread of sound from one end to the other. Whether or not we listen to a conventional stereo system or not, that is indeed the effect when one hears a stereo record with the orchestra distributed across a wall; and that is the way we ordinarily expect to listen to music of this type. The Bose 901 still

yields the full wall effect; and indeed, it is quite possible that actually listening to such music in a concert hall, similar effects would be noted. That is possible. But when listening to soloists, one expects to hear the sound emanating from a fairly local source. His violinist should occupy a limited space in a room, and a piano should not be so large that it seems to stretch from one end of the front wall to the other end. That conflicts between what one hears in the case of a soloist and one expects to hear -- one actually knows a violin is a small instrument [7-104] and yet hears it as coming from a large area, that conflict could lead to some distress. That is the reason for the statement that they might become annoying when listening to soloists.

* * *

[7-107] Q. Mr. Seligson, I believe you will recall that Dr. Bose, during his testimony in this case, stated that it was his belief and opinion that it was scientifically impossible for anybody to hear instruments through the 901 seem to grow to gigantic proportions or tend to wander. Do you recall that testimony?

A. Yes, I do.

Q. Do you agree with that testimony?

A. No, I do not.

Q. Do you have an opinion as to whether there are scientific principles which explain the phenomenon of appearing to hear enlarged or wandering instruments which you experienced in listening to the Bose 901?

A. Yes, I believe there are a number of scientific theories which might singly or in combination account for the possibility that instruments will grow to

large proportions and wander.

Q. Could you state the basis of your opinion, please? A. Yes, if I may go to the sheet, another sheet of paper.

Q. Sure, do you want a clean sheet or do you --

A. A clean sheet of paper, I think, perhaps -- [7-108] thank you. Your Honor may recall when Dr. Bose testified sometime ago he started --

THE COURT: Excuse me. Have you taken precautions so there will be no possibility of mistaking this drawing with the drawings already --

MR. POLLET: We can separately number that sheet, your Honor.

THE COURT: Why don't you do it now?

MR. POLLET: Surely. I guess perhaps we should use a letter. I think Dr. Bose used numbers. We will mark this as A in the upper right-hand corner.

THE COURT: Dr. Bose used numbers only and no letters?

MR. PERRY: The sheets were numbered 1 through 13. They have been stapled together and marked as Plaintiff's Exhibit 21, your Honor.

THE COURT: All right.

THE WITNESS: Perhaps your Honor remembers when Dr. Bose testified, he at one point drew a violin in free space out in an open field and showed the sound rays from the violin spreading in various directions. [7-109] He indicated a listener placed some distance away and said under those circumstances the listener would -- testified substantially under such circumstances the listener would never perceive the violin to be very wide. I forget the distance he used. Then he supplemented that statement and that drawing with another

one in which he placed a band shell behind the violin. We represent this by this little dot. Call that the violin, and let's call this a reflecting band shell behind the violin and put a listener somewhere out here, a pair of ears; and the sound waves from the violin strike the band shell and are reflected forward toward the listener and also a direct ray is directed toward the listener. Under these cirumstances, Dr. Bose stated that the sound image was the width of the stage, but that the listener would not be able to perceive a violin itself as being the width of the entire stage.

THE COURT: Would not?

THE WITNESS: Would not. That was Dr. Bose' testimony. This is based on a well-known [7-110] principle. It's a principle that's about perhaps 140 years

old, discovered by a famous scientist by the name of Joseph Henry; and it is known by various names. I'd like to call it by one of the names by which it's known, which is the fusion effect, f-u-s-i-o-n; and it predicts that if one of the rays of the sound reaches the listener ahead --

THE COURT: You don't mean a ray, do you?

THE WITNESS: Ray, r-a-y.

THE COURT: I've never heard sound referred to as a ray.

THE WITNESS: We call them rays for convenience. Notice the way the drawing is made. We can plot the course taken by the sound waves by means of straight lines emanating from the violin, bounding off reflectors, reaching a listener; and for purposes of convenience, we can refer to these lines as rays. The fusion

principle states that if one such ray reaches the listener ahead of the others, the listener's perception, his illusion, will be that all the sound will seem to originate at the point from which the earliest ray arrives; [7-111] in this case, the violin. The direct ray reaches the listener first because all the other rays have been diverted to reach the reflector and then to the listener, and they will take slightly longer to reach the listener than the first ray. The listener, under these circumstances, perceives all the sound coming from the violin, all loudness only, by the reflections from the reflector. But now, if your Honor would imagine, we put the violin behind a screen of some kind, sort of a dressing screen. That obscures the violin from the view of the listener. So this direct ray is severely weakened on

its way to the listener.

This fusion theory, which is promulgated by a -- which was very clearly explained by a scientist by the name of Helmut Haas, will predict that, under those circumstances, when the direct rays sufficiently weaken, the listener will cease to hear the sound originated from the violin, and he will direct his attention to the next earliest arriving ray or rays; in this case, perhaps several rays will reach him so close together that, under those circumstances, his [7-112] perception of the image shifts away from the violin and back to the reflector. The perception of that violin will broaden.

This is not merely a sound source broadening in the manner in which Dr. Bose described, but this will be really apparent widening of the sound. It will

seem to emanate from many, many points in space behind the violinist. To the extent which this occurs is predicted by Dr. Haas; and he states that, if the sound of the first arriving ray is weaker by a factor of 10, approximately, that there is a variance here -- by approximately 10 -- then the sound of the next arriving ray, the fusion principle, which is responsible for the localization of sound, will begin to fail. And the listener will begin to hear sound emanating from a vaguer and vaguer and vaguer source.

This is one principle which could account for the widening of a sound which I perceived when I listened in CU's listening room. There are other scientific theories which can also account for this, perhaps taken together. One of them is known as backwards

inhibition. That is another fancy name, and it [7-113] is a theory which was promulgated by the Nobel laureate, Dr. George von Bekesy, who is perhaps one of the most brilliant innovators in the field of psychoacoustics and, indeed, upon his theories are based some of the most well-recognized theories of hearing. He discovered an interesting fact, or at least he mentioned this fact. I don't know if he was the original discoverer of this.

If we listen and we hear a distinct sound, and I will represent this by a little chart which will indicate what happens in the course of time, a graph, if you will, your Honor, of occurrences as a function of time. If at some moment in time we hear an impulse of noise, perhaps a short swishing sound, and then some few moments later, actually 30

thousandths of a second to one tenth of a second later, we provide another such swish of sound, there is something which operates in the psychophysical hearing system that will actually suppress the very first sound, weaken it, sometimes to the point where it cannot be heard at all. If such delays are present, and they are present in most rooms because reflections, after all, take longer to reach the ear than the [7-114] original sound, and if those reflections occur in the proper time frame, then it is possible for them to suppress that first sound, the first sound of the instrument. The Bose loudspeaker is somewhat similar to this. I will draw it right over the violin, if I may.

Q. (by Mr. Pollet) Mr. Seligson, perhaps it would be more convenient for you to use another page?

A. All right. I'll be happy to do it. Is it all right if I label it myself B?

Q. Yes. If you will just write the letter B in the upper right-hand corner and circle that so it will be separately identifiable.

A. If I'm correct in my exposition of the scientific theories, and I believe they are, when a Bose loudspeaker is placed in an ordinary listening room and placed in the following fashion, indicating this roughly -- your Honor will remember a pentagonal shaped loudspeaker with eight drivers facing rear and one toward the front, the principle which must operate for the listener to fuse the images to perceive them as properly located in space, not widened, not wandering, is that the sound from the front facing [7-115] loudspeaker

arrives at his ears a little ahead of the sound from the rearward facing loudspeakers. Perhaps I'm not drawing this quite correctly. They pass through the room by reflection; but not only arrive earlier by virtue of the fact that it protrudes further into the room, but it must arrive with sufficient strength at the listener's ear for him to be able to achieve the fusion. If Helmut Haas' principle is to be adopted, the strength of the sound reaching his ear must be at least one tenth of the strength --

THE COURT: You say the fusion will take place in the ear?

THE WITNESS: The fusion is a psychological effect, your Honor, which takes place in the ear. It's apart from the physical acoustics.

THE COURT: Just like rapidly successive light?

THE WITNESS: Exactly.

THE COURT: You see it as a continuous light, but it's really --

THE WITNESS: Exactly, your Honor, which is the principle, perhaps of the motion picture. We see successive frames; we perceive [7-116] them as a continuous effect. There are similar illusory characteristics which operate in the hearing principle as well. I think we mentioned ventriloquy, where it's possible to be fooled into thinking the dummy speaks. The mind is truly an astonishing thing, and we should not be terribly surprised that we can be amazed at its functioning.

In the case of Bose, we must maintain the adequate strength of signal to his ear from the front loudspeaker to minimize the possibility -- the fusion principle will not function. The

backward inhibition effect may also arise, possibly because some of the rays, as they reflect through the room, may reach the listener with sufficient strength to partially dim the initial sound from the front facing loudspeaker. This is a second effect which is added on to the first. Now, there are other explanations which other scientists have offered. There is a scientist who works for Bell Telephone Laboratories by the name of Gardener who has written a number of papers which are concerned with image localization, broadening, and, indeed, [7-117] wandering; and he has shown, as other workers have shown, that it is possible to move an image back and forth across a wall, let's say, beyond the sources of sound from which they originate simply by means of varying the times by which they are propagated and

their amplitudes. It is a well-known effect, and it has been utilized commercially to prepare -- if I use the word phony, quote, unquote -- stereo records from monophonic sources. There are ways to doctor a simple record, monophonic record, and make it sound as if it were coming from a broad area. Some of these effects he enumerates in his papers. One of the reasons this may occur, he hypothesizes, in the course of the sounds' travels to our ears, the sound may undergo changes in its response characteristics, in its loudness versus frequency characteristics, due to the fact that furnishings in the room or different wall treatments may select, absorb, and reflect sound; so by the time the sound reaches our ears, the sound from a pair of loudspeakers is somewhat different. The left loudspeaker may

produce a [7-118] somewhat different spectrum of sound at the ears than the other loudspeaker. For example, it might look like this. This would be loudspeaker No. 1, and this would be loudspeaker No. 2's sound loudness as it reaches the ear is a function of frequency when this occurs, this phenomenon occurs. Then too, it is a well-known fact, extremely well-known fact, that image broadening displacement effects can occur. Gardner points that out in his paper.

Finally, there's still another scientific principle at work, which has been espoused by a person by the name of Queen, who has espoused a theory that says that image broadening and widening will occur if the rays of sound reaching the ear from a loudspeaker which result from the sideways dispersion of energy --

in other words, your Honor, you may recall that we talked about a polar response curve. The sound does not reach the ear of a listener from a loudspeaker in a single ray, but is likely to have a rather ragged look; and that this hyperpolar response will change with different frequencies. Queen has postulated and has performed calculations which are reasonably convincing which [7-119] shows that, if this effect occurs, the listener will perceive a broadened sound image.

In the case of the Bose speakers, we have performed polar measurements and have data to show that the sound which is thrown into the room from behind will vary this way with frequency; and, therefore, it would not be terribly surprising to me to find that broadening effects will occur. In what proportions

these effects will operate in the Bose loudspeaker and in what combination, it is nevertheless clear that such effects are recognized in the literature and they are documented.

THE COURT: Are you saying that the lateral, what appeared to you as the lateral movements of the instruments were caused by this --

THE WITNESS: Were caused by -- I've enumerated four possible mechanisms by which this could occur.

THE COURT: Does that explain, in your opinion, the lateral movement of the instrument?

THE WITNESS: Yes.

THE COURT: I think your statement in the article which says they moved into the room, just as if they came forward, as well --

THE WITNESS: The example given for

the [7-120] movement into the room refers only to a widened violin and a widened piano and was meant to imply only that the widening and movement was across the rear wall from the two speakers.

THE COURT: May I see that article? What page?

MR. POLLET: 274, your Honor, in the right-hand column toward the bottom.

THE COURT: In the right-hand column, did you say?

MR. POLLET: I believe so, although at this point I'm not sure I know my right from my left.

THE COURT: "It tended to wander about the room." It didn't say from side to side or against the walls alone, but it says --

THE WITNESS: I believe the next sentence is meant to explain that. It then says, "For instance," as an example

of the effect. In that instance cited, I believe, it is quite clear that it means that a violin was ten feet wide -- we are talking about the width and stretching from wall to wall.

THE COURT: The word "about" means around, [7-121] doesn't it?

THE WITNESS: It was, your Honor, it was meant to mean about the rear wall, between the speakers.

THE COURT: That isn't what it says, though.

THE WITNESS: I understand.

THE COURT: All right. Go ahead. Just a moment, does Consumers Union still have the 901s with which you made your observations?

THE WITNESS: Yes, your Honor.

THE COURT: So that the same phenomenon you stated you observed when you conducted these tests would be

repeated in a demonstration today?

THE WITNESS: Your Honor, I believe that your Honor requested such a demonstration, and I believe counsel --

THE COURT: Would it still --

THE WITNESS: Would it still occur? Yes, there is no reason to expect that it would change due to the change of the calendar years or the evolution of time.

Q. Mr. Seligson, subsequent to the completion of the tests and measurements on the loudspeakers which [7-122] you have discussed, what was the next step taken in the preparation for the article which ultimately appeared in the May 1970 issue?

A. The next step was to prepare a written report which documented our findings. That report was to serve as a document to be sent to our editorial department to assist them in preparing

the manuscript for publication.

Q. Did there come a time when you prepared a draft of such a report?

A. Yes.

* * *

[7-123] Q. Looking at Plaintiff's Exhibit 10, Mr. Seligson, can you identify that for us, please?

A. Yes, this appears to be the rough draft of the manuscript which we prepared and which we ordinarily refer to as reports to editorial.

Q. Can you tell us who prepared this rough draft?

A. Do you mean who originated it? It was dictated in part by me, written in part by Mr.Lefkow, and was typed up by a secretary.

* * *

[7-127] Q. Yes. If you turn to Page 27, please. I believe you stated that

that portion from Page 27 through 34 was dictated by you, is that correct?

A. Yes. One moment. To 34, you say?

Q. Yes. A. Let me check. Yes.

Q. Do you recall when that portion was dictated by you? A. No. It would have been middle to end of January, but I'm not quite certain of the date.

Q. What year, please? [7-128] A. 1970.

Q. And does the material found in Pages 27 through 34 refer to the Bose loudspeaker?

A. Yes, I believe it does, but -- yes, there are references to the Bose loudspeaker.

Q. And are there references in these pages to the special listening tests conducted by you and Mr. Lefkow?

A. I would like to read that.

(Pause.)

A. (Continuing.) I see a reference to the cricket test, and I see references to the third or special listening test.

Q. Can you identify where in the document there are references to the third listening test, the special listening test?

A. Yes, that would be beginning on Page 29.

Q. Can you set forth where in the page that material is found?

A. That special test description begins right at the top of the page where it says, "A second experiment was conducted. We repeated the A-B-C listening experiment, this time using as program material a wide variety of stereo records."

[7-129] Q. And does that continue in reference to the special listening test?

A. Yes, it does. Yes. Going down to the middle here, on Page 30, it still continues to discuss that matter. I would say it continues until the insert on my copy, in red ink, at the very top of Page 30.

* * *

[8-5] Q. Can you tell us what the next step in the process leading to the Consumer Reports article on loudspeakers was, following the dictation of the draft to Editorial?

A. Yes, I reviewed it, dictated the copy and made such changes or recommendations or deletions as I felt were appropriate and then submitted the report to my superior for review.

Q. And who would that be? A. That was Mr. Carl Nagel.

Q. Did anybody else other than Mr. Nagel review the draft to -- the report

to Editorial? A. Yes. I believe Mr. Monte Florman, Mr. Nagel's supervisor reviewed it.

Q. And following the review of Mr. Florman and Mr. Nagel, what happened? [8-6] A. Following their review, the report was retyped with all of the appropriate modifications.

THE COURT: Is it necessary to go over the process of drafting and redrafting of it? Of what consequence is that? What is the relevance, please?

MR. POLLET: Your Honor, the process by which the test ends up becoming an article is a great deal of importance.

THE COURT: By what reason?

MR. POLLET: That there was care and reasonable steps taken in putting the test reports into a finished article.

THE COURT: But not the printing process.

MR. POLLET: We were not talking about the printing process.

THE COURT: It's part of the production of a publication itself. It has nothing to do with the merits. He said, no changes were made. Why take up the Court's time.

MR. POLLET: Your Honor, I will.

THE COURT: Don't argue with me. Just watch the relevancy of your questions.

MR. POLLET: I would like to put into evidence the final version of the report to Editorial.

[8-7] THE COURT: Wasn't the final version actually published and is identical with the reasons of this action? Isn't it?

MR. POLLET: It is not necessarily word-for-word identical, your Honor, but the process by which the tests and the

evaluations become --

THE COURT: Perhaps it will take less time to have you aware, but go ahead. Unless it takes an inordinate amount of time, I wish you had been more effective and more efficient.

MR. POLLET: I don't believe it will take more than five minutes.

THE COURT: Go ahead.

Q. Mr. Seligson, I show you a document which has been marked for identification as Defendant's Exhibit A-N. Can you tell us what that is, please?

A. That is the final copy of the report for Editorial.

Q. And did you --

THE COURT: What did you say it was marked?

MR. POLLET: A-N.

Q. Did you play a role in preparing

that document? A. Yes.

Q. And does a date appear on that document? A. Yes.

[8-8] Q. What is that date, please?

A. February 4, 1970.

MR. POLLET: Your Honor, at this point I'd like to move to introduce into evidence Defendant's Exhibit A-N, the final version of the report to Editorial.

THE COURT: Is that one and the same document?

MR. POLLET: Yes, your Honor.

MR. PERRY: I have no objection.

THE COURT: Admitted.

(Defendant's Exhibit A-N, Final Editorial Report, entered in evidence.)

Q. Mr. Seligson, what is the relationship between the report to Editorial and the final published article in May, 1970?

A. The report to Editorial serves as

the guide for our Editorial Department in preparing the manuscript which was published in the magazine.

Q. And is the report to Editorial distributed outside the technical department?

A. Yes, it is.

Q. Where is that distributed?

A. It is distributed to various departments that may wish to review it. The executive directors, the technical directors, the Editorial Department, of course, the [8-9] market division, our library and several other departments I cannot offhand recall.

Q. What is the next step in the publication leading to the article after a submission of the report to Editorial to the Editorial Department?

A. A writer of the Editorial Department prepares a manuscript.

Q. Was that done in this case?

A. Yes.

Q. And after the manuscript is drafted by a writer in the Editorial Department, what happens next?

A. It is submitted to the technical department for review.

Q. Mr. Seligson, I show you a document which has been identified as Defendant's Exhibit A-O and I ask you if you can please identify that document, please?

A. This appears to be it.

THE COURT: No, tell us what it is?

A. This is the Editorial Department manuscript which was submitted to the technical department for review.

Q. And is there handwriting on that document? A. Yes.

Q. And can you identify the handwriting? A. Most of the handwriting

on the document appears to be mine. There are a few notations in another [8-10] handwriting. I'm not certain whose.

MR. POLLET: Your Honor, at this point, I would like to move to introduce into evidence Defendant's Exhibit A-O.

MR. PERRY: No objection.

THE COURT: Admitted.

(Defendant's Exhibit A-O Editorial Department Manuscript, entered in evidence.)

Q. Did you review the Editorial manuscript after receiving it from the Editorial Department? A. Yes.

Q. Does anybody else review the Editorial manuscript after --

A. Yes. Mr. Nagel and Mr. Florman, to my knowledge.

Q. Can you tell us what the next steps are, please, in the publication of the article ultimately appearing in the

May, 1970 issue of Consumer Reports?

A. After that manuscript is reviewed, the manuscript is set into type and various editorial revisions occur until it finally appears in the magazine in its final form.

Q. Can you tell us who in Consumers Union reviews the editorial manuscript prior to publication?

A. Well, among the members -- there are the members of the technical department I mentioned earlier, myself, [8-11] Mr. Nagel, Mr. Florman, and possibly Mr. Kaplan at the time. And then there are individuals in our library division, marketing division, and members of the editorial staff itself, the editors.

* * *

[8-61] Q. Going back in time, Mr. Seligson, and putting yourself in the

time period between September 1969 and May, 1970, can you tell us what your attitude and feelings were toward the Bose Corporation and its products during that time period?

A. I had no special feelings toward them, neither animus nor especially favorable of them. I regarded them as I would regard any other manufacturer of loudspeakers.

* * *

[9-2]

Cross Examination by Mr. Perry

* * *

[9-70] **Q. At the time of the June 3, 1970, meeting, at Consumers Union, where were the Bose 901 speakers that Consumers Union had tested as part of the loudspeaker evaluation project which commenced in 1969?**

A. You mean physically?

[9-71] Q. Yes.

A. They were in the electronics laboratory.

Q. At Consumers Union? A. Yes.

Q. Were you present during the meeting when Dr. Bose asked for a demonstration of those loudspeakers? A. Yes.

Q. You recall that he did ask for a demonstration? A. Yes.

Q. Was a demonstration made? A. No demonstration was made, Mr. Perry.

* * *

[9-73] Q. How long would it have taken to set up the demonstration? A. Oh, about half an hour, I suppose.

Q. Did Consumers Union have whatever equipment was necessary to make the demonstration readily at hand? A. Yes.

* * *

[9-74] Q. Let me ask you this: As of

this moment, do you have any plans to make a demonstration of those same 901 speakers for the Court?

A. There are some plans, yes.

Q. You plan to do it? A. I understand his Honor requested it. I certainly would never contradict his Honor's request.

Q. All right. Now, in 1969 and 1970, Alan Lefkow was an engineer at Consumers Union, right? A. Yes.

Q. What was his title then? A. Project engineer.

Q. Did he work under your supervision and direction on the loudspeaker evaluation project which began in 1969? A. Yes, he did.

Q. Were you his immediate superior at that time? A. Yes.

Q. You were his boss, so to speak? [9-75] A. Yeah.

Q. And from time to time, did you make evaluations of his work and report them to people higher in management?

A. In an informal way, Mr. Perry.

Q. Were you in a position to influence his compensation? A. No, Mr. Perry.

Q. Amount of pay? A. No.

Q. If you gave him a good recommendation, wouldn't that help him get a raise?

A. I don't think so, Mr. Perry. The Consumers Union plant was then unionized, and I don't think merit increases were given out.

Q. Were you in a position to have a negative impact on his career at Consumers Union if you wanted to?

A. Yes, I believe so.

Q. Is he still employed at Consumers Union? A. Yes, he is, Mr. Perry.

Q. What capacity? A. He is a senior project engineer.

* * *

[9-88] Q. Who were the panelists for the cricket test?

A. Their names were Hal Shair, and the second panelist on the cricket test was Mr. Joseph Selserman.

Q. When the article published in May, 1970, referred to a panel for the cricket test, did you mean to refer to only those two men?

A. Yes, Mr. Perry.

Q. To you, two is enough for a panel? A. Yes, Mr. Perry, I believe that a panel may be defined as more than one.

Q. Would you agree that the use of the term "panel" [9-89] to describe two listeners is at least misleading?

A. Well, I don't know to whom it

might be misleading. I'm not certain whether I can say anything about that. It seemed to me at the time that panel would be adequately describing two people.

Q. I had in mind that it might be misleading to people who read the magazine. Wouldn't you agree that the use of the term "panel" to describe two people would tend to mislead readers of the magazine?

A. Well, our readership is mostly laymen. They are not audiophiles, and they are not professionals, by and large; and I'm not certain whether it would or wouldn't mislead them. I cannot put myself in their frame of mind, necessarily.

Q. Well, as far as you are concerned, wouldn't you agree that the use of the term "panel" to describe two

people may be very misleading or at least may be misleading?

A. I don't think it would be very misleading. If it's misleading at all, then it could be possibly a mite misleading under certain conditions. I don't know.

* * *

[9-99] Q. All right. Now, I want to turn your attention, Mr. Seligson, to a portion of the article which was published by the defendant in the May 1970 issue of Consumer Reports. Now, Plaintiff's Exhibit 7 -- and I think there is a copy in front of you, isn't there?

A. Yes.

Q. And I want to invite your attention to that part which says, "Some loudspeakers of special interest," beginning on page 274. Does your Honor

have a copy of the article?

THE COURT: Do I have it?

MR. PERRY: Here is Exhibit 2, which is identical.

Q. At Page 274 and 275 appears some material relating to Bose 901 speaker. Did you prepare the draft report to editorial along with Mr.Lefkow which was the basis of that portion of the article?

A. Yes, Mr. Perry.

Q. And after editorial revised your draft and prepared a first draft of the article, did you check that work for accuracy?

[9-100] A. Yes, I checked the first draft of the editorial copy.

Q. After it was set in type, did you see the galleys? A. Yes, Mr. Perry.

Q. Did you check the typed galleys for accuracy? A. Yes, Mr. Perry.

Q. Would it be fair to say that you

approved the final text of the article as it was published, at least so far as it relates to the Bose 901?

A. Well, Mr. Perry, I did not have the authority to approve. I simply was able, by my position, to offer corrections or recommendations for changes. But the right of approval was not mine.

Q. Did you suggest any changes in what you saw, that is the galleys of the article?

A. I don't recall what I might have suggested to the galleys, at the galley stage.

Q. Do you recall suggesting any changes in the article which were not made?

A. No, I simply don't recall the entire process. There may very well have been changes which I suggested which were

not made.

Q. At least if there was anything that you consider technically inaccurate, you could have objected to it?

[9-101] A. Yes.

Q. Is there any portion of the material there about the Bose 901 which you now believe to be inaccurate?

A. No, Mr. Perry.

Q. Or misleading? A. Or misleading.

* * *

[9-128] Q. Now, I want to turn, sir, to another portion of the article, Plaintiff's Exhibit 7. I'll read it to you.

> **"Worse, individual instruments heard through the Bose system seemed to grown to gigantic proportions and tended to wander about the room. For instance, a violin appeared to be ten feet wide, and a piano stretched from wall to wall."**

A. One moment, Mr. Perry. I seem to have misplaced --

Q. Page 275 in the right-hand column, the last paragraph.

* * *

[9-130] Q. What were the musical instruments which wandered about the room during that test?

A. I believe we said they tended to wander about the room.

Q. All right. What were --

[9-131] A. And the same two instruments would -- no, I take that back. The instruments which I recall as tending to wander about the room was the violin.

Q. Not the piano? A. No, I don't recall it wandering about the room.

THE COURT: I think the piano is stretched across.

THE WITNESS: It stretched across the room, yes, your Honor.

Q. And were you in the listening room at Consumers Union when you heard these phenomena? A. Yes.

Q. Do you recall the dimensions of that room? A. Approximately.

Q. What were they? A. The room was about 28 feet long by about 18 feet wide by about eight and a half feet tall.

Q. In Answers to Interrogatories earlier in this case, the defendant gave the dimensions of the listening room. I refer to Interrogatory 41-K, as 18 feet, 9 inches by 24 feet.

A. Oh, 24. Right.

Q. Does that sound about right?

A. It sounds about right.

Q. All right. I'm going to ask you to step down to the [9-132] easel, if I may, your Honor, and draw us a sketch of the listening room and where the loudspeakers were located when you heard

these gigantic wandering instruments. And then I'm going to ask you to draw some other things in, so make it a nice big sketch, if you would. It needn't be precisely the scale, but roughly so.

(Witness complies.)

A. This is approximately the room.

Q. Now, could you draw in the loudspeakers in their location?

(Witness complies.)

A. Pardon me for the --

MR. POLLET: Excuse me, Mr. Perry. Could you move to the side?

MR. PERRY: Yes.

Q. How long did you listen to the Bose 901 on this occasion? A. For several hours, Mr. Perry.

Q. Did you and Mr. Lefkow remain seated in one place throughout those several hours?

A. Not for the entire period, Mr.

Perry. We did get up. It was difficult to sit in one place for several hours.

THE COURT: What kind of recording did [9-133] you use?

THE WITNESS: We used a large variety of recordings, your Honor, from our supply. We have a closet full of recordings which have been accumulated over the years.

THE COURT: Did you select any particular pieces of music?

THE WITNESS: With the exception of one piece, which I recall definitely, there was random selections from classical to some popular music.

THE COURT: Do they include vocal --

THE WITNESS: Yes, your Honor.

THE COURT: -- as well as instrumental?

THE WITNESS: Yes.

Q. Were there some chairs there,

where you and Mr. Lefkow were seated part of the time? A. Yes.

Q. Could you draw in the appropriate location of the chairs?

(Witness complies.)

A. Again, that is my best recollection, I would say, somewhere like that.

Q. For the record, you have drawn two U-shaped objects approximately in the center of the room.

A. Sort of hooking down like an armchair.

[9-134] Q. Very good. And from time to time, while you were listening, did Mr. Lefkow get up and wander about the room?

THE COURT: No, the instruments.

Q. First, I want to know about Mr. Lefkow.

A. I'm not certain, Mr. Perry. I know he must have gotten up. But it was

very difficult to sit in a chair all this time. But I cannot be certain, you know, how he wandered or what he did.

Q. Well, during this listening test, did you get up and wander about the room at all?

A. I believe I got up once or twice and walked around, yes.

Q. And would that be fairly characterized as wandering about the room?

A. I would say that you could say I wandered about the room. Yes.

Q. All right. Perhaps you would take the orange marker, if you would, and show on the chart where you wandered about the room during this test?

A. I cannot recall with any great precision.

Q. I understand, but do the best you can.

(Witness complies.)

A. I think I may have gotten up and wandered here. I may have gone over to the loudspeaker and back. And [9-135] I may have gone to this end of the room and back, and something like that, perhaps.

Q. You have drawn orange lines running from the chairs to the left-hand speaker and from the chairs over to the right-hand side of the drawing, right?

A. Yes.

Q. All right.

A. There is a little bit of speculation here, because I really don't recall the precise path of my travels about here.

Q. All right. A. It's been too many years.

Q. Would you please take the blue marker, which I hand you, and draw the location of the wall to wall piano which

you heard?

(Witness complies.)

Q. Now, you have drawn a blue line toward the top of the drawing, immediately behind the two speakers, extending from side wall to side wall?

A. Yes.

Q. Is that right? A. Yes.

Q. And, finally, would you take the red marker, which I give you, and draw the location of the ten foot wide violin when you first heard it? Is that when [9-136] you first heard it, ten feet wide?

A. You say "ten," or is it -- excuse me one moment, please?

Q. Sure. A. Ten or nine?

(Pause.)

A. Yes, ten. Okay.

(Witness complies.)

A. Something like that.

Q. So you have drawn a red line in the top of the room or the -- at the back wall behind the speakers, approximately?

A. Essentially, yes.

Q. Now, would you, with the same red marker, draw the path which that violin followed as it wandered about the room?

A. Well, I cannot draw a precise path. I can only indicate by means of motions made by this pencil along the drawing in a crude approximation of what it might have been. I cannot give you exact points. I don't remember.

Q. I understand.

A. I cannot say it was here, this dimension, at one time, and it was here at another time. I can only indicate in a broad way what my perceptions told [9-137] me my sound seemed to be doing.

Q. That is all we ask is your best memory.

A. Well, if I -- as I sat in the chair and listened to the loudspeakers playing, I found that it appeared to me that at one given point in time the violin might be located, say, here.

(Witness draws.)

Q. You have drawn a circle with an X in it? A. Yes.

Q. All right.

A. At some moment or two later, as I was trying to concentrate to discover where the violin might be, it seemed to have shifted position. It seemed to be, say, coming from here.

(Indicating.)

Q. Could you put a letter on the circle you just drew, like a Y?

A. A Y will superimpose on the X. You wouldn't see that too well. Suppose I label them above the circle?

Q. That would be fine.

A. X and Y, is that all right?

Q. Sure.

(Witness complies.)

Q. All right, and did the violin wander anywhere else? [9-138] A. Yes, sometimes it would appear to be coming from, let's say over here (indicating).

Q. All right. Anywhere else?

A. Well, in general, I would have to say that from one time or another, it would appear to originate from any point between those two arrowheads. The sound would appear as if it were originating anywhere between those two arrowheads which I put here. (Indicating).

Q. And by the two arrowheads, you refer to the arrowhead at either end of the red line which extends approximately from the side of speaker to the side of speaker; is that right?

A. Approximately.

THE COURT: How wide is the room, did you say?

THE WITNESS: This room is 18 feet wide, sir.

Q. And have you completed drawing where you remember the violin wandering?

A. I would fill -- I'd probably end up filling that space in between with little x's because it seemed to shift its location from moment to moment.

Q. Between arrowheads? A. Between arrowheads, I would end up with a lot of [9-139] circles.

Q. All right. The record will be clear then. Did I ask you did the piano wander about the room?

A. I believe you did.

Q. What was your answer? A. I believe I didn't recall that it did.

Q. All right. Now, is that the phenomenon which you intended to describe

when you said in your draft report to editorial that instruments tended to wander about the room?

A. That is essentially the phenomena I intended to describe when I said the instruments tended to wander about the room. Let me read the article to see if that was exactly what I said.

Q. Perhaps you'd like to refer to Exhibit 10, which is your draft report also?

A. Do you need me to stay here?

Q. No, you may resume the witness stand if you wish.

(Witness resumes stand.)

A. I'll get my reading glasses back on.

Q. Certainly. I know that problem well. In fact, in your draft report to editorial, you used slightly different language, didn't you? You said in

Plaintiff's Exhibit 10, [9-140] "Instruments not only could not be placed with precision but appeared to suffer from giganticism and a tendency to wander around the room," and so forth; right?

A. Yes.

Q. Those are your words? A. Those are my words.

MR. POLLET: Mr. Perry, could we just have the page number identified, please?

Q. Could you tell us the page number I just read from? A. Oh, yes. Page 29.

THE COURT: Of which exhibit?

MR. PERRY: Plaintiff's Exhibit 10, your Honor.

* * *

[9-145] Q. All right. Would you agree that as of June 1970, with conventional loudspeakers, the sound may appear to come from any or all points between the speakers?

A. Mr. Perry, I think I have already pointed out that if you define it sharply enough, I can answer that question. If the recording that is being played [9-146] is that of an orchestra with violins on the left and trumpets in the middle, let's say, the double bass on the right, in that case when you play such a recording on a conventional loudspeaker, you would in ordinary circumstances hear the violins on the left, the trumpets in the middle, and double bass on the right.

Q. Yes. But with an individual instrument, you would not hear sound spread between the two speakers, is that your testimony?

A. In a properly functioning stereo loudspeaker system with an individual instrument at a fixed location during the recording process, not moving about the room, actually, you should hear the sound

as coming from one given position on the wall in front of you.

Q. From a single fixed position? A. Yes, if you are seated in a chair, Mr. Perry --

Q. Yes.

A. -- some distance from the loudspeakers and listening to a pair of stereo loudspeakers located some ten or twelve feet in front of you, you should hear that instrument localized or apparently coming -- The sound of that instrument localized or apparently coming from some location on that wall. It should not shift.

[9-147] Q. Would you then agree, sir, that as of May 1970, the average person would regard it as a disadvantage to have loudspeakers which made the individual instruments appear to wander about the room?

A. Not necessarily, Mr. Perry. We did not say that either in our story. What we said was that with orchestral music, such effects seemed inconsequential. Then we went on to say But we think -- we think. It's an opinion -- they might -- and we qualified it again -- become annoying when listening to soloists. We stated it with a double qualification and totally eliminated the orchestral music. That is lots of instruments. There, we felt that was of no consequence whatsoever.

Q. Didn't you think that people reading about the gigantic wandering instruments might be deterred from purchasing the Bose 901 as a result?

A. They might have just as well been fascinated to hear this and have been spurred on to buy it.

Q. Are you serious?

THE COURT: What?

THE WITNESS: Spurred on to listen to it and to buy it. The effect is not a complete negative. We mentioned that in the story.

Q. Are you trying to be funny, or is that -- [9-148] A. I'm not trying to be funny, Mr. Perry.

MR. POLLET: Objection. The counsel is arguing with the witness.

THE COURT: Yes, that is all.

Q. Do you really -- do you mean, sir, that you thought that people might regard the gigantic wandering instruments as an advantage which would induce them to purchase these speakers?

A. There it is in print.

Q. No, No. I'm asking what your state of mind was. When the article was published, did you think that readers might read about the gigantic wandering

instruments heard through the Bose 901 and thereby be induced to purchase Bose 901 speakers?

A. I said I thought they might be induced to go and listen to these effects and might grow to like them.

THE COURT: No. When you use the word "worse," it means that it's compared with something else. In this case, it's obvious it was compared [9-151] with what immediately preceded it. So what immediately preceded it was not something good, but rather something undesirable. Otherwise, you wouldn't have said "worse," would you?

THE WITNESS: Or perhaps there was a greater error on perception of what would have been a conventional error. In other words, there was an error in the perception of the sound, as indicated by the first sentence; and that this error

in perception is intensified still further when the instruments grew to gigantic proportions. The very effect which is the criterion of the loudspeaker, we were quick to praise, and this is, in my opinion, based upon the very effect we have noted here. We said-- I'm afraid I cannot find that one sentence I was looking for. Here it is. I have it. The Bose 901 seemed-- when it came to music, the panelists immediately noticed a remarkable difference between the system. It's that difference that counts. The Bose 901 seemed considerably more spacious and reverberant actually to the point of giving the impression that the walls of the listening room had dropped away. The effect was rather dramatic and was felt from any listening position. This already indicates there was something different [9-152] about the

Bose loudspeaker in the manner in which it reproduced stereo sounds compared to other loudspeakers. A very positive and beneficial thing, as a matter of fact. But there was a change in perception. Listeners would hear things differently with the Bose than with other conventional loudspeakers. How annoying that might come was qualified in our report. We said, "With orchestral music such effect seems inconsequential. But we think they might-- might become annoying when listening to soloists." And that is the way we saw the net overall effect. It was conceivable to us that individuals, some individuals, might think them annoying, and they would have to listen for themselves. As we say later, "Listen for yourselves and decide for yourselves." It was not an outright negative approach. It's quite positive,

I think.

* * *

[9-153] Q. Mr. Seligson, why did you use the words "tended to wander about the room" to describe what you have drawn on the board?

A. Well, I don't know what made me pick that particular choice of words. Would you have been more satisfied if we said "across,"-- I think not-- instead of before. I have the feeling you would have objected in either event. The word "about" meant just as I drew it on the board. Now, I so testified in my deposition--

Q. Would it have been more accurate in your judgment to say that the instruments tended to move back and forth between the two speakers?

A. No, I don't think so, taken in context of the way it's described.

Remember, the effect is carefully described in a few sentences later. It's hard to mistake.

Q. Is there anything in the article which you think conveys to the reader the idea that the instruments stayed down at one end of the room and didn't come out and wander about, like you wandered about, where you have drawn the orange line?

[9-154] A. Yes.

Q. What is that?

A. I would think that the reader would get that from reading that a violin appeared to be ten feet wide and a piano stretched from wall to wall. This is no hint of depth or whatever, entering into the room.

MR. PERRY: I'll offer as the next exhibit of the plaintiff, the sketch made by the witness of the listening room and

the gigantic wandering instruments.

MR. POLLET: No objection, your Honor.

THE CLERK: Plaintiff's Exhibit Number 29.

(Sketch made by witness marked Exhibit 29.)

THE COURT: Admitted.

* * *

[10-2] Q. Good morning, Mr. Seligson. Calling your attention once more to Plaintiff's Exhibit 7, the copy of the article published in the May, 1970 issue of Consumer Reports, at Page 274 is this language:

> "Worse, individual instruments heard through the Bose system seem to grow to gigantic proportions and tended to wander about the room."

You told us yesterday that the only instrument that you observed to be moving during the special listening test of

January 23, 1970, was the violin. Can you think now of any other instruments, having in mind that the plural form of the word is used in the article, that moved about on that day?

A. Well, Mr. Perry, I recall that some human voice [10-3] did, and in that broad sense you might consider the human voice an instrument, I do recall that, but I don't recall any of the others.

Q. All right. Now, after January 23, 1970, was the next occasion on which you listened to the Bose 901 speakers June 16, 1970, when you demonstrated them for Mr. Florman?

A. I believe so, yes.

Q. And who else was present on that occasion?

A. To the best of my recollection, there was Mr. Morris Kaplan, Mr. Florman, of course, Mr. Lefkow, myself, and I

believe Mr. Nagel, sir.

Q. And did you set up the speakers on that occasion in the same location that you had on January 23, 1970?

A. No, Mr. Perry.

Q. Yesterday, you drew for us a sketch, which is now Plaintiff's Exhibit 29, of how the loudspeakers were set up on January 23. I wonder if you would be good enough to step down and make a similar sketch -- was it in the same listening room?

A. Yes, it was.

Q. Of the listening room on a different piece of paper, showing how the speakers were set up on [10-4] June 16 of 1970. I will get you a marker. If you would use the black to outline the room and the location of the speakers, please?

(Witness complies.)

A. This is the outline of the room;

and on the 16th, the speakers were here. Again, this is only a rough sketch. And I am not claiming --

THE COURT: You better speak up, the reporter has to take it down.

THE WITNESS: Again, this is a very rough sketch and I am not certain that the scale of the drawing is proper. Soemthing like that.

THE COURT: Is that a new diagram?

THE WITNESS: Yes, this is a new diagram, your Honor.

THE COURT: This time you have it at the bottom of the page.

Q. You have drawn two five-sided figures toward the bottom of the square or rectangle, which represents the walls of the room, is that correct?

A. Yes, that is correct.

Q. Incidentally, where was the door to the listening [10-5] room?

A. It was, let's see now, it opens up here. It was over here. I believe -- I am trying to remember which side the hinge was on.

Q. It doesn't really matter. If you could just point out where the door was.

A. Over here.

Q. You have drawn two lines and a box on the right-hand side to show the door?

A. That is the door, yes.

Q. Fine. And could you, with the orange marker, please indicate where the various persons who were present while the speakers were played on that day?

A. There were several people and they were seated roughly in this area. I am not drawing individual chairs. There were several chairs.

Q. All right. You have indicated in orange a rectangle with cross hatching to

show approximately where the people were located, right? A. Yes.

Q. On this occasion -- and I don't want you to tell us what anybody else said, but only what you [10-6] observed yourself, on this occasion, on June 16, 1970, did you think that you heard any instruments wander about the room?

A. Yes, Mr. Perry.

Q. Which instruments? A. Well, we played a number of them and I can't recall specifically -- certainly heard violins. I heard the human voice. There may have been others, but I don't recall precisely the instruments and the manner in which they wandered.

Q. Can you indicate for us with the red marker on this chart where the violin appeared to wander or move on that occasion?

A. Here I am not quite as certain.

I was observing the test, but was not as immersed as I was during the special listening test, so I will indicate an area that would roughly indicate this. I would say somewhere -- and this is an approximation -- somewhere in this region. I will cross hatch it.

Q. Indicating that the cross hatching in red at the bottom of the drawing, right? A. Yes.

* * *

[10-16] In the 1979 test did you hear any instruments which to you appeared to wander about the room?

A. In the sense that I described yesterday, that it [10-17] was difficult for me to focus on a specific location from which the sound appeared to come, that it seemed to shift from moment to moment, or as my attention would lapse for a moment and then return to the

instrument, that was true.

Q. And with respect to what instruments did you hear this wandering phenomenon in 1979?

A. I did notice it for the violin.

Q. Was it essentially the same phenomenon which you had described with respect to the September, 1970 test, which you sketched in Plaintiff's Exhibit 30?

A. Yes, essentially the same.

Q. Did you hear it in both the morning session and the afternoon session?

A. Yes, Mr. Perry.

Q. Perhaps you would draw for us on the latest chart the apparent location of the violin during the morning and afternoon sessions.

A. All right. From such areas as this.

Q. You have drawn a red rectangle with cross hatching at the top of the drawing to indicate where you thought you heard the violin in the morning session, and a similar rectangle at the bottom of the drawing to indicate where you heard it in [10-18] the afternoon session, is that correct?

A. Yes, Mr. Perry.

* * *

[10-19] When you said the violin was ten feet wide, does that mean the same thing to you as saying the violin was wandering about the room?

A. No, I don't think they are mutually exclusive, but it doesn't mean quite the same thing, no.

A. What is the distinction between the two things?

A. With the violin wide, the impression is one predominantly of sound

coming at you from roughly the entire area in front of you. In other words, roughly from in front of the entire area. But individual notes, however, may occasionally seem to focus a little better in one location than in another and give the impression that that is where the violin is for that moment. And it is a shifting impression. It is something which is part of that vagueness which we mentioned in the story. We said simply it became apparent that the panelists could pinpoint the instruments much more precisely with a standard speaker system than with the Bose [10-20] system. It is that difficulty in pinpointing the location that leads to some of the problems. It also makes it difficult to describe.

* * *

What I am trying to get at is:

Do you recall that you heard a violin which at all times appeared to be ten feet wide and which moved, or did you hear simply sound coming from [10-21] an area ten feet wide?

A. As best as I could describe it, it would be that -- if you can imagine peering at an array of lights from a distance, a very large array of lights from a distance so when you view them they seem like a blur of lights somewhere in front of you; and in this array of lights there may be individual lights which twinkle more strongly and focus one's attention upon them, but the twinkling shifts from point to point so that one's attention is drawn first to one spot, then to another, but it would be difficult to see whether at those times when one's attention shifts to a bright spot, whether one has suppressed

the fact that there is a broad light source behind. This is something that occurs with time and it is a perception. It is difficult to recall precisely the manner in which I heard it, but that is about the best analogy that I could give you.

* * *

[10-22] Q. You are aware, aren't you, that a violin playing notes of different frequencies will have a different radiation pattern or polar radiation pattern for each frequency?

A. Yes, Mr. Perry. Dr. Bose has discussed that earlier in his testimony, I believe.

Q. You don't disagree with that, do you? A. No.

[10-23] Q. And doesn't it follow that as the radiation pattern of the violin changes with the frequency, that at times

the different notes will appear to come from different spots around the violin because the radiation is stronger in one direction at one time and another direction at another time, depending on frequency?

A. I would expect that to happen so infrequently that it would not influence my ability to judge the localization or the effective image with the violin.

Q. You would expect it to happen, but you would not expect it to make the violin sound enlarged, isn't that correct?

A. In effect, yes.

Q. And what you heard on January 23, 1970, was entirely consistent with what you would have expected to hear with an actual violin playing notes of different frequency, wasn't it?

A. You mean reproduction throughout the Bose loudspeakers?

Q. Yes.

A. No, I don't think it was consistent with what I would hear from a violin. We are dealing with a completely different animal, so to speak. [10-24] This is a recording and it is being played back through a loudspeaker whose directional properties did not resemble those of the violin, if I understood Dr. Bose's drawings correctly.

Q. Well, with respect to the apparent movement of the location from which specific notes came, that you observed on January 23, 1970, wasn't that entirely consistent with what you would expect a live violin playing between the two speakers and playing notes of different frequency?

A. No.

Q. How did the two differ?

A. The directional properties of the

Bose 901 loudspeaker are very much unlike that of a violin.

Q. Is that the only way you can distinguish the two?

Q. Well, of course there are many other ways you can distinguish a violin from a Bose loudspeaker, but certainly --

Q. I am talking about the specific phenomenon about different notes appearing to come from slightly different locations.

A. Mr. Perry, I think that the penomenon may be [10-25] accounted for by the fact that the Bose loudspeaker directs most of its sound energy away from the listener. It is designed deliberately to do so in a predominant fashion, whereas the violin does so in an entirely different fashion and not at all like the Bose 901 loudspeaker. One would not be surprised, I think, that their

behavior in terms of listener perception would be different.

Q. Well, we will get into the acoustical theories in a few minutes. But for the moment I want you to tell us this: With an actual violin, you would expect some apparent movement of the source of sound as frequency changed because of the varying polar radiation patterns, would you not?

A. I would expect them to occur relatively infrequently.

* * *

[10-47] THE COURT: What I am groping for is this: How would such minimal differences affect the sound in such a way as to cause the listener to think of the instrument as wandering?

THE WITNESS: Well, oh, he -- well, that is a different question. You are not talking about the quality of the tone

of the sound, but the wandering has to do with the judgment of where the sound appears to originate, from the localization of the sound. And there, the time of arrival can be of great significance. The time by which the sound passes the two ears of the head can strongly determine for the listener where he seems to believe the sound is originating. He uses those clues the way a rangefinder or optical rangefinder uses light being separated by the two mirrors at the end of a rangefinder. The minute time differences in the two ears is sufficient to force a judgment upon the listener, which I suppose we are born with or perhaps learn to acquire, and we swivel our [10-48] heads accordingly.

THE COURT: But the differentials in the arrival of the sound are identically the same with respect to all sounds that

originate from certain sources.

THE WITNESS: From a certain point, yes, your Honor. In other words, if they were --

THE COURT: Here we are dealing with a behavior on the part of an instrument such as the Bose loudspeaker, which apparently behaves differently from other loudspeakers.

THE WITNESS: Yes, it does. There is a very big difference.

THE COURT: Can that be caused by the differences in the time of arrival that we are talking about because the time of arrival is the same, identical with all sounds that originate in that particular place, regardless of whether it is a Bose instrument that sends it out or whether it comes --

THE WITNESS: There is a vital difference in the time of arrival between

the Bose and other loudspeakers, if we discuss that aspect of it.

[10-49] THE COURT: Even though they are located in the exact same position in a room?

THE WITNESS: Yes.

THE COURT: How can there be a difference in the time of arrival? The speed of sound is the same under similar circumstances. The speed of the sound which emanates from one instrument will be the same as the speed of sound emanating from another instrument, isn't that true?

THE WITNESS: The speed of sound is the same, your Honor.

THE COURT: All right. How can there be differences in the time of arrival?

THE WITNESS: The difference is that the conventional loudspeaker directs all of its sound toward the listener; whereas

the Bose speaker directs a great portion towards the walls.

THE COURT: We are not in an open space, not in a shell, a concert band shell, but we are dealing with a room that is 15 by 20 or whatever it is.

THE WITNESS: That is right.

THE COURT: Which is relatively [10-50] small.

THE WITNESS: It will amount to the order of between 2,000ths of a second and 10,000ths of a second.

THE COURT: But that difference is the same regardless of the instrument from which it emanates, if they are situated in the same location in the same room?

THE WITNESS: But the conventional loudspeaker, your Honor, will not send its high frequency sounds towards the walls of the listening room the same way

the Bose does because they are blocked by the body of the cabinet. Those sounds go directly toward the listener. In that case, the predominant force of sound is directed away from the listener toward the walls, and a small portion is directed by means of one loudspeaker toward the listener. As a result, with the Bose loudspeaker the listener will experience two sets of arrivals, first from the sound of the loudspeaker and then, a fraction of a second later, the sound which comes from the rear walls.

THE COURT: You are not conscious of that?

[10-51] THE WITNESS: The listener is not conscious of that slight different in the time of arrival. The listener, however, is conscious of the effects which it can produce. That is a well-established law. If your Honor will

remember, the only clue we have to a location of sound source is the difference in time of arrival of the two ears. They are about, say, eight inches apart in the head. Yet, that slight difference, which is in the order of perhaps 8/10ths of a millisecond, is sufficient to clue us in on it. They have, in the case of a Bose loudspeaker, a far larger time span, 3 milliseconds, larger than what we utilize in two-eared listening. And that is certainly significant in terms of listener perception.

* * *

[10-102] **Q. Do you know of any technical or professional paper or textbook which refers to a musical instrument which appeared to a listener to wander about a room when its sound was played through a loudspeaker?**

A. I don't recall any, Mr. Perry.

* * *

[11-70] "Q. I am going to read another quote.

'As for sound quality, if the Bose 901 had been rated with the main group of tested speakers, it would have fallen between the high and medium accuracy groups.'

'Please identify the Consumers Union test records which you believe support that statement.

"A That statement was a judgment based on our examination of the [11-71] results of the listening test, which was analyzed by Dr. Pike, and which is called the listening test for accuracy, in which the Bose loudspeaker ranked in the middle groups.

"We felt, however, that that was not a fair ranking of the Bose loudspeaker, because the listening test for accuracy asked the listeners to respond to differences in sound, and in view of the fact that the Bose 901 had a type of aural space that was different from the forward radiating loudspeakers of most of the other loudspeakers in the test, that such a difference

would crop up unfavorably to the disadvantage of the Bose.

"Therefore, we felt that on the basis of our listening, as reported in books, Plaintiff's Exhibits 11 and 36, that the Bose was a much better loudspeaker than the listening test for accuracy would indicate.

"On the other hand, such statements [11-72] as found in Plaintiff's Exhibit 36, 'Have clear sound but noticeably booming in lower mid range. After listening for about an hour boom became fatiguing and annoying.'

"And statements in Exhibit 11: 'Appears to have exaggerated mid bass. Not particularly objectionable, but noticeable.'

"And the statement: 'Lower mid range or upper bass sounds boosted, adding a 'tiring,' annoying quality for the sound,' led us to the judgment that the Bose loudspeaker, if it had been ranked as quoted from our article, would be just slightly below the top accuracy groups."

* * *

[11-81] MONTY FLORMAN, SWORN

DIRECT EXAMINATION BY MR. POLLET

Q. Mr. Florman, could you, please, state your full name and home address.

A. Monty Florman, .31--

THE COURT: Is that F-l-o-r-m-a-n?

THE WITNESS: F-l-o-r-m-a-n.

THE COURT: --m-a-n, Florman.

A. 31 Vernon Parkway, Mt. Vernon, New York.

Q. Are you employed, Mr. Florman? A. Yes, I am.

Q. Where are you currently employed? A. At Consumers Union.

Q. Is that the defendant in this case? A. Indeed.

Q. What is your current job position at Consumers Union? A. I am technical director.

Q. Can you tell us, just in general fashion, what your duties and

responsibilities are as technical director?

A. Yes. I'm responsible for all of the laboratories which comprise six technical divisions at Consumers Union and whose output comprises almost entirely all of the product rating material that is published in Consumer Reports magazine and in other publications of Consumers Union.

Q. How long have you been employed at Consumers Union? A. Approximately 31 years.

[11-83] Q. And during the years 1969 and 1970, I take it then, you were engaged as C.U.'s associate technical director? A. Yes.

Q. Can you tell us what your duties and responsibilities were in connection with C.U.'s electronic division in the period 1969 to 1970?

A. They were analogous to my present duties but limited instead of to the entire technical department which I now am responsible for. Rather I was in charge of three of the technical divisions at that time: the electronics division, the appliance division, and the special projects division.

Q. And what duties and responsibilities did you engage in with respect to the electronics division on '69 and '70?

A. Overseeing the approximately ten projects, ten technical test projects that would be in progress at any given time in terms of administering them, keeping track of them, reviewing reports of various kinds emanating from the definitions in the course of the project up to and including the report to editorial which is the technical report

provided to editors of Consumer Reports.

Q. Would your duties and responsibilities then end with the completion of the technical report?

A. No.

Q. Can you tell us what they would be beyond that point?

A. Subsequently to my review of the technical report and my [11-84] comment thereon and consultations about that technical report with the division head of the electronics division in this case, in this instance I should say, there would be a subsequent series of reviews following submission of the technical report to the editorial department where that report would be converted by professional writers into a report for publication in the magazine. That report, in turn, would be turned over the electronics division for review,

checking, line by line checking, and it would come from that department to my office for review by me in much the same way that the original report was reviewed by me. It would then be turned over to the editorial department and changes by them, perhaps in consultation with us, if there were any questions. The same process would pertain for the galley proofs, for the second galley proofs, for the page proofs, for the second page proofs, and for what used to be called cast pages which were the final proofs that went to the principal for publication.

* * *

Q. Mr. Florman, are you familiar with the article on loudspeakers which was published in Consumer Reports in May 1970 issue? A. Yes, I am.

Q. And were the duties and

responsibilities which you carried out with respect to the preparation of these tests, the carrying out of the tests, and leading to the publication of that article similar to the duties and [11-85] responsibilities which you have just set forth?

A. Yes, they were.

* * *

[11-100] Q. Mr. Florman, has Consumers Union ever published any inaccurate information in the pages of Consumer Reports during the 30 years that you have been connected with Consumers Union?

A. We have published a great many corrections in Consumer Reports to correct errors that have been published.

Q. Does Consumers Union have any policy with respect to publication of correction of errors?

A. Our policy is to correct errors

at the earliest possible time.

Q. You mentioned that at the June 3rd meeting Dr. Bose seemed to you to make a concerted attack upon Mr. Seligson's competence. Were you surprised at that?

A. Yes. I expected something quite different.

Q. Do you consider Mr. Seligson to be competent?

THE COURT: We'll have our noon recess.

A. Yes.

MR. POLLET: Yes. Thank you.

(Lunch recess at 12:57 PM.)

[11-101] Q. Can you tell us the basis for your yes answer to the prior question considering Mr. Seligson's examination?

A. Yes. Since his employment in 1956, as an electronic engineer and --

THE COURT: Keep your voice up.

A. I said since Mr. Seligson's employment in 1956 as an electronic engineer, his subsequent promotion to senior project engineer, and his then subsequent promotion to head of the electronic division, he has been involved in virtually every project that Consumer Reports has published that involved home speaker entertainment equipment, which covers the gamut from radio, stereo receivers, all kinds of amplifiers, pick ups, television sets, color, black and white, and loudspeakers, of course. And has tested and reported on and responsible for reporting on literally hundreds, if not thousands, of brands and models of these products. I measure his competence by the response of our customers as any purveyor of a product measures the quality of the product. We too sell a product, our product is

magazines. And we have two and a quarter million readers, our complaint mail, [11-102] which is a measure of our quality control, is extremely small, virtually a trickle. And in Mr. Seligson's area, there is practically no mail at all. Our reports are very well accepted, the response of manufacturers has been extraordinarily good. We have an occasional complaint, occasional letter, but by and large, that division, under Mr. Seligson's direction, has done extremely well, and indeed, we have received more capital in the electronics division than any other division so as to maintain state of the art. In other words, we have a great deal of confidence in that division and therefore spend a great deal of money on it.

* * *

[11-104] Q. Have you listened to the

Bose 901 loudspeaker subsequent to June 3, 1970? A. Yes, I did.

Q. When was that, if you can recall? A. It was within two weeks after the meeting, probably June 16.

Q. What were the circumstances which led to your listening to the Bose 901s on or about June 16?

A. A very strong curiousity, and beyond curiousity, a very strong sense of responsibility on my part, and also on the part of the then technical director, Morris Kaplan. Our concern was whether, in fact, an error had been made or the loudspeaker mischaracterized in any way, and we both felt that it was extremely important that we listen to the loudspeakers and make our own, come to our own conclusions.

* * *

[11-106] Q. Can you tell us, please,

what you observed or heard during the listening test?

MR. PERRY: Again, if that calls for what somebody else said, I object on the grounds of hearsay.

Q. What you heard from the loudspeakers during the listening test. Please do not tell us what others may have [11-107] told you, but simply what you observed or what you heard emanating from the loudspeakers?

A. A number of selections, musical selections, were made for us. There were woodwinds, there was a piano solo, a violin solo, there was some orchestral music, was voice, and what I heard was the sound of individual instruments being unfixed in space, that is to say, the piano was much wider than any piano could possibly be. In fact, it appeared, the sound of piano appeared to extend from

wall to wall, the violin assumed yet another kind of characteristic. It was not only larger than I would expect a violin to sound, but in addition, the violin wandered about the room. It at one moment sounded towards the right, at another moment, it sounded high in the room, yet another time --

THE COURT: What do you mean by high?

THE WITNESS: Higher than the normal playing level. Perhaps as high as the ceiling. To my ear, it appeared to wander about. The voice similarly was not fixed, and like the violin, wandered about the room in a way that exactly, in my judgment, exactly paralleled what we reported about these loudspeakers in the May 1970 issue.

* * *

[11-111]

CROSS EXAMINATION by Mr. Perry

* * *

[11-115] Q. Mr. Florman, did you make this memo dated June 4, 1970, on June 4 or on June 3 of that year?

A. If it's dated June 4, I would assert that I wrote it on June 4.

THE COURT: Mr. Perry, for the record, what is that document? Did we have it marked for identification?

MR. PERRY: I haven't yet, your Honor. I will if you wish.

THE COURT: Well, it's my practice the moment you show a document to a witness, you have it first marked for identification.

MR. PERRY: Fine.

THE COURT: The record will be clear.

MR. PERRY: We have lost the clerk for a [11-116] moment, but I'll make a note to have it marked.

THE COURT: What is it a memo --

MR. PERRY: It's a memo dated June 4, 1970, from Mr. Florman to file with a copy shown on the face to Mr. Kaplan. And the subject matter is described as BOSE.

THE COURT: Does this purport to be the substance of what happened on that occasion?

THE WITNESS: Yes, your Honor.

THE COURT: On the 3rd?

THE WITNESS: On the 3rd.

Q. Mr. Florman, did you testify earlier that Dr. Bose didn't say on June 3 what he objected to about the contents of the article that your company had published? A. Yes.

Q. Didn't he say that he thought that the description of the function of the equalizer in the Bose 901 loudspeaker system had been erroneous?

A. I think I may have made a

reference to that in my memo. May I have a look at it?

Q. First, I would like your memory?

A. My memory doesn't serve --

THE COURT: Can you have that marked now?

MR. PERRY: Yes. Could this be marked as [11-117] the next Plaintiff's Exhibit for identification?

THE CLERK: Plaintiff's Exhibit 33, so marked.

(Plaintiff's Exhibit 33, Florman memo dated 6/4/70, marked for identification.)

Q. Perhaps if you look at the paragraph on Page 2 which bears the number 1, that would be of some help to you.

(Pause.)

A. The answer to your question obviously is yes, there was some such discussion.

Q. And in looking at Plaintiff's Exhibit 33 for identification, does that refresh your recollection that Dr. Bose complained about several different aspects of the statements the defendant had made about his loudspeakers?

A. Yes, indeed.

Q. And I want to read you a sentence from your memo and ask if it's consistent with your memory of what was said: "Bose took extremely strong exception to the concept of wandering and expressed the view that on theoretical grounds such an observation was patently impossible." Did Dr. Bose in substance say that at the meeting?

[11-118] A. I can only respond in the context of what I wrote. I don't remember it happening.

* * *

[12-142] Q. Now, I want to read to you,

sir, another portion of your memorandum of June 4, 1970, Plaintiff's Exhibit 33 for identification, and ask you to explain what various initials mean. It reads as follows:

> "After the meeting W.S. reported to M.F. that C.E.W. felt that we were, in his opinion, weakest in our arguments about the wandering instruments."

THE COURT: What are you reading from?

MR. PERRY: Mr. Florman's memorandum of June 4, 1970, your Honor, Plaintiff's Exhibit 33 [12-43] for identification.

Q. What or who was meant to be identified by the initials W.S.?

A. Walker Sandbach.

Q. He was the executive director of Consumers Union at that time? A. Yes.

Q. M.F. is reference to you? A. Yes.

Q. C.E.W. is who? A. Colston

Warne.

Q. He was the president of the organization at that time? A. Yes.

Q. So the meaning of the sentence, I take it, is that after the meeting Mr. Sandbach reported to you that Mr. Warne felt that you were weakest in your arguments about the wandering instruments, is that correct?

A. That is correct.

Q. And did that actually happen?

A. I am sorry?

MR. POLLET: Did what actually happen?

Q. Did Mr. Sandbach report to you that Mr. Warne felt that Consumers Union was weakest in its arguments about the wandering instruments?

[12-44] A. That actually happened.

* * *

[12-48] Q. Let me ask you this, Mr.

Florman: During the meeting on June 3rd, didn't you hear Dr. Bose say that what was reported in Consumer Reports about the enlarged, wandering instruments, was a scientific impossibility or words to that effect?

A. Yes.

Q. Do you remember now that he did say that at the meeting?

A. I believe he did say that was-- the words scientific impossibility--

Q. Something like that? [12-49]

A. Something like that.

Q. And you knew, you had read the article, the May, 1970 article by that time, hadn't you? A. Yes.

Q. And is it your testimony that after Dr. Bose said that the widened, wandering instruments was a scientific impossibility, you never went to Seligson and said, "Larry, what did you hear," or

something to that effect?

A. No, I wanted to hear it myself before questioning him.

Q. And to this date, you never asked him what he heard? A. No.

* * *

[12-114] Q. Mr. Florman, you approved the publication of an article in the May 1970 issue of Consumer Reports which at Page 274 says, "Worse, individual instruments heard through the Bose system seemed to grow to gigantic proportions and tended to wander about the room." Did you approve that language?

A. Yes.

Q. When you approved that language, sir, what was the meaning to you of the words within it "wander about the room"?

A. In the context of having read the whole article, starting on page 274, my reading of that particular [12-115]

paragraph and sentence seemed to grow logically out of the story, and I had no -- I had no reason to question --

THE COURT: No. The question is: What did the quoted language mean to you when you read it?

Q. The words "tended to wander about the room," what did you understand those words to mean?

A. Well, what I believed was that when listening to the loudspeaker, the instruments referred to were not localized and tended to wander around the room. I don't know how better to answer.

Q. I guess I'm asking you, if you can, to tell us what you understand the word "wander" to mean in that context.

A. Well, very much as I described this morning. Of course, that was after I had heard the loudspeakers. But before having heard them, it meant a lack of

localization; that is, as if listening to an orchestra or to a solo or to a group of instruments, what it meant to me was that the instruments did not remain fixed in a specific location.

Q. When you read those words in 1970, did you construe them as meaning that the instruments [12-116] had appeared to move about in random fashion throughout the room without following any fixed pattern?

A. Well, the mental image I had was of the sound moving about in front of the listener.

Q. Would you read the question, again, please?

(Question read.)

A. No.

Q. You took them to mean that the instruments moved in one plane, is that correct?

A. Well, in a plane in front of the listener, rather than behind the listener.

Q. Why did you so construe the words in 1970, when you read them?

A. Out of experience, sitting on the couch and listening to a loudspeaker my experience has been that the -- that the music emanates from in front of me rather than from behind me.

Q. Yes.

A. And if the sounds were to wander about the room, it would wander about in a 180 degree arc in front of me.

Q. Wouldn't you agree that the normal average person reading the words "wander about the room," in that article, in its context, would have a mental [12-117] impression of instruments moving about the room, meaning into various locations throughout the room?

A. I am very reluctant to speculate on that. I don't know what the average person would derive from this. I have not questioned anybody. I have not questioned anybody.

Q. Well, you approved the language? A. Yes, but I haven't done a survey to find out what the average person would think.

Q. What did you intend the reader to think?

A. That there was something unique and special about this loudspeaker and that one of the things that Consumers Union was pointing out was that the characteristics of the speaker were such that the sound appeared, the sound of instruments, appeared to move rather than remain stationary.

Q. When you approved the publication of that language, what did you intend

readers of the article to infer from the word "about," as used in the phrase "wander about the room"?

A. I must say, I never -- I never really pondered that.

Q. If you ponder it now, would you agree that the word "about," as there used, is synonymous with [12-118] around?

A. Yes.

Q. So it means wander around the room, right? A. Yes.

Q. Right? A. Yes. Yes.

THE COURT: Your answer is yes?

THE WITNESS: Yes.

* * *

[12-124] Q. Would you agree, sir, that as of 1970, the magazine Consumer Reports had an excellent reputation for integrity and accuracy? A. It did and does.

Q. And would you agree that millions of people tended to rely upon the

information contained [12-125] in the magazine in deciding what products to buy?

A. It's my hope that they did, yes.

Q. You have no reason to doubt it, do you? A. No.

Q. And would you agree that Consumers Union, in 1970, had the power by giving a bad report to a product in some instances to virtually destroy the marketability of that product?

A. No, I have no such information. In fact, I have contrary information.

Q. At least you would agree, wouldn't you, that a negative report on a product in your magazine might well tend to diminish the sales of the product?

A. No, I couldn't agree with that.

Q. You couldn't? A. No.

Q. You don't think the people read the magazine to help decide what to buy?

A. I certainly agree with that.

Q. And don't you think they act upon the recommendations in the magazine?

A. I trust that they do, but the studies that have been done by outside agencies have indicated that sales of products do not necessarily decline as a consequence of a poor rating in Consumer Reports.

* * *

[12-128] MR. POLLET: Your Honor, defendant has no redirect. We would like at this point to move that Plaintiff's Exhibit 33, which has been for identification, be introduced into evidence, your Honor.

MR. PERRY: I have no objection.

THE COURT: Admitted.

(Plaintiff's Exhibit 33 entered in evidence.)

* * *

[12-129] ALAN LEFKOW, Sworn

Direct Examination by Mr. Beil

Q. Mr. Lefkow, will you please state your name and address for the record.

A. Alan Lefkow. I live in Thiells, New York.

* * *

[12-130] Q. Are you currently employed at the Consumers Union? A. Yes.

Q. What is your title now?

A. I believe it's -- it's either senior project engineer or senior project leader. It changes every time the union contract changes.

* * *

[12-138] Q. Did you participate in the 1969 and 1970 test of loudspeakers at Consumers Union? A. Yes, I did.

Q. Was this your first experience with laboratory testing of loudspeakers?

A. My first formal experience.

Q. Had you had some informal experience prior?

A. There was some simple tests that were part of the laboratory courses in the undergraduate school.

Q. Had you ever listened to loudspeakers prior to this?

A. Oh, yes, over all the years previous to that, all the shows and hi-fi stores whenever possible.

Q. In preparation for these tests at Consumers Union, did you receive any kind of training in the measurement or evaluation of loudspeakers?

A. Yes, Mr. Seligson, on a continuing basis conducted somewhat, if you will, individual class lectures strictly for me using the blackboard, and I studied many textbooks that were available in the laboratory, particularly Beranek, Acoustics was one of the [12-139]

main texts that Mr. Seligson was concentrating on in his lectures, and whatever other textbooks were available.

Q. Do you remember which ones they were?

A. There was several. There was Fundamentals of Acoustics. That, I think, is by Kinsler & Frye. Then there was Olsen's -- Olsen had two books; they're Acoustical Engineering, and there is a first and second edition. There was a very funadmental book, Vibration and Sounds, by Morse. And then there was another book. Beranek had another book, Acoustic Measurements.

Q. You read these books in preparation for these tests?

A. I read the portions of the books that were pertinent to the tests we were doing.

Q. You said Mr. Seligson conducted

classes or tutorials; did he also conduct any kind of experiment in preparation for the testing of the loudspeakers?

A. Yes. Whenever he covered a principle, he tried to actually go to the laboratory and demonstrate. I would actually take a measurement, and we would actually look at that in detail. I remember one occasion where he actually asked me to go and measure the parameters of a loudspeaker driver, just following the techniques in Beranek, Acoustical [12-140] Measurements, and then do some calculations on it, and then try the driver out and see if indeed the calculations matched the results.

* * *

[12-141] Q. Were you concerned during the participation in this test to please your superior, Mr. Seligson, in any way?

A. I don't understand what you say,

please. I carry out his directives.

Q. Did Mr. Seligson ever indicate to you that he wanted you to follow his views as to loudspeakers and [12-142] what the tests showed, or to be independent, or to criticize him?

A. No, he very clearly said that I should exercise a complete independent judgment, speaking up whenever I felt that I had a criticism or a comment to make. And he also asked me what I thought and, you know, did I agree or disagree with whatever he was saying; so on and so forth. That was continuous throughout the project.

Q. Did he ever say to you or indicate to you that if you didn't agree with him, you wouldn't pass probation?

A. No.

Q. Did he ever imply it in any sort of way?

A. No. As a matter of fact, he kept reassuring me constantly to speak my mind, you know.

* * *

[12-150] Q. Let me finish the question. Who else besides you participated in the special listening test on January 23, 1970? A. Mr. Seligson.

Q. Could you describe for us how the test was conducted?

A. Well, we had the Bose 901 loudspeakers set up in the listening room, and we had a -- - well, we happened to have an extensive record collection, and we played a variety of records covering as much -- as wide a range of different types of music as we wanted to listen to, and we listened for several hours. We sat in different positions, walked around, and that is basically it.

* * *

[12-154] Q. Can you tell us what you heard when you were listening to something other than orchestral music?

A. Yes, we played a monophonic record, or it may have been more than one record. I recall one in particular, and that had a wide central image sound image. [12-155] In other words, the conventional stereo monophonic sound usually seems to emanate from the fairly sharpest point in the center.

THE COURT: What?

THE WITNESS: From a fairly sharp localized point. And with the Bose 901, it was a wide spreadout image.

Q. Did you listen to any soloist played through the Bose 901?

A. Yes, we listened to piano and violin. The piano was very wide.

THE COURT: Back to orchestral music. The fact that four drivers are in the

rear and then they propel the sound toward the wall, that would tend to diffuse the sound, wouldn't it?

THE WITNESS: It would be reflected at many different angles off the wall.

THE COURT: Did that improve the overall effect of the performance or take away from it?

THE WITNESS: I wasn't judging whether or not it sounded good or bad. I was trying to, you know, make clear in my mind what type of image I was actually hearing.

THE COURT: Well, wasn't that purpose to ask you to determine whether the loudspeaker that [12-156] was being tested was pleasing to ear generally or not pleasing? Wasn't that one of the objects to determine, whether or not it would appeal to the customers, to the purchasers?

THE WITNESS: That was not the purpose of this test.

THE COURT: What was the purpose?

THE WITNESS: The purpose of this test was to, you know, nail down what were the actual effects that one would hear when listening to the Bose 901.

THE COURT: Wasn't it important to determine whether the effect was pleasant or unpleasant?

THE WITNESS: That would -- that would be a matter of opinion and --

THE COURT: Well, of course.

THE WITNESS: Yes, and I just heard -- there was only one thing of the sound that I found annoying or disturbing. The orchestral spread, I did not find disturbing at all.

THE COURT: What?

THE WITNESS: I did not find the orchestral spread disturbing at all. I

thought it [12-157] was very nice.

THE COURT: All right. Go ahead.

Q. I believe you were telling us what you heard with respect to solo instruments. I think the first instrument you started describing was what you heard when a piano solo was being played through the loudspeaker.

A. Yes, the piano seemed very wide in the sense that you could hear the various tones from the piano come in at many points right across the front of the room. And the violin, as the violin is played, the violin -- the source of the notes seemed to change as he played different notes. As he went up and down the scale, I heard the notes coming from different points, spread out between the two speakers.

Q. Were these effects with soloists as pleasing to you as the effects you

heard with the orchestra?

A. No, they seemed somewhat unnatural.

* * *

[12-158] Q. Did you record your observations upon the conclusion of this listening test?

A. Yes, I wrote it in down in this data book.

Q. The data book you are referring to, is that marked as Plaintiff's Exhibit 9, on the top of the page of the cover?

A. Right. Correct.

Q. I show you the page of that data book labeled "Personal Observation on Bose 901 Upon Listening for Several Hours." Is that the page on which your observations are recorded?

A. Yes, mine started at the lower part of the page.

Q. Could you please read for the record what appears in -- is that in your handwriting?

A. Just the black ink is my handwriting.

Q. Read what appears at the bottom of the page into the record, please, and continuing onto the next page.

A. "Lower midrange or upper bass sounds boosted, adding a 'tiring', annoying quality to the sound. Sound spread out over entire wall. Stereo effect seemed diffused; trouble in [12-159] pinpointing location of soloists, especially voices. Violinists (soloists) shifted position depending on scale he was playing (different notes came from different directions.) Monophonic material sounded almost like stereo. Treble range had very smooth and pleasing quality. If it weren't for upper bass emphasis would have tone quality on par with best in project."

Q. What appears after that last line you just read?

A. My initials and the date 1/23/70.

THE COURT: What exhibit are you reading from?

MR. BEIL: Exhibit 9, your Honor.

* * *

[13-39]

Cross Examination by Mr. Perry

* * *

[13-109] Q. The basic concept of stereo sound is that there is a two-channel recording; and when the music is played back, some things come through the left channel and some through the right. Isn't that the basic idea?

A. That is not necessarily true. In many systems, you don't hear the sound coming specifically from the left or right. They come at various points between left and right. They could come from the center.

Q. Is that a common phenomenon, for the sound to come from various points

between the left and right speakers?

A. That is common, yes.

[13-110] Q. You wouldn't regard that as unusual, then?

A. Unusual?

Q. Yes. A. In a stereo system, no.

THE COURT: Well, stereo sound is a sound that comes from more than one point?

THE WITNESS: Well, you would expect it to come from more than one point.

THE COURT: If it doesn't, can you refer to it as stereo?

THE WITNESS: A stereo recording may have a soloist in the left channel; and that soloist may come from one point on the left.

Q. With stereo speakers you would expect that, at times, the sound would come from various points between the speakers?

A. If that was what was intended.

Q. Now, that would happen with any good quality brand of speakers, wouldn't it?

A. Again, if the recording had the information contained.

* * *

[13-118] Q. When you, sir, use the term "image" in the phrase "best image of all speaker systems listened to," what did you mean by image?

A. I had played orchestra material; and I considered that wall of sound a good stereo image for orchestra material.

Q. Did that orchestra material include any solo performances? A. No.

Q. You are sure of that? A. Yes, positive.

Q. What records did you listen to; did you make any record of it? A. I didn't make any record of it.

Q. Do you remember? A. I remember some of them.

Q. Ten years later you can remember the names of records you listened to?

A. Yes. Not all of them; I can only -- I remember going out and buying them for my own personal collection.

Q. Oh, I see. On November 24, 1969, or thereabouts, when you made the entries in Plaintiff's Exhibit 16, after listening to the Bose 901's had you heard [13-119] any instruments that appeared to be of larger dimensions that the actual physical dimensions of the instrument?

A. I had not listened to soloists.

Q. That is not the question.

A. I only listened to orchestra and when you say instruments --

THE COURT: For those that you did listen to, you say you listened only to orchestra records and not to solo

records. As to those that you did listen to, were the phenomenon described by Mr. Perry -- could you repeat the question?

MR. PERRY: Yes.

Q. In November, 1969, before you made the entry in Plaintiff's Exhibit 16 about the Bose 901's, while listening to the Bose 901's, had you heard any musical instruments which appeared to you to be of greater physical dimensions than the physical dimensions of the actual instruments?

A. No.

Q. And when you made those notes in Plaintiff's Exhibit 16 about the Bose 901's, had you heard any instruments in music played through the Bose 901's which appeared to wander about the room?

A. Up to this point, no.

[13-120] THE COURT: Well, how many records had you listened to on the Bose

901's?

THE WITNESS: Just a handful. I mean, up to this point --

THE COURT: A handful means seven or eight?

THE WITNESS: No. There were some records I liked the music of and I would use the same record. I only listened to the --

THE COURT: Did you listen to more than one record?

THE WITNESS: Yes, I listened for about an hour on the Bose.

Q. And during that hour you didn't hear any instruments which seemed to be of enlarged proportions, beyond the physical dimensions of the real instruments, nor any wandering instruments, is that correct?

A. That is correct.

* * *

[13-126] Q. Now, in this special listening test on January 23, 1970, only the Bose 901 speakers were tested, right?

A. Yes.

Q. Was it Mr. Seligson who said that the Bose 901 speakers were to be subjected to this test of January 23, 1970? A. Yes.

Q. Did it strike you as unusual at the time to have a test on only one pair of loudspeakers done after all the other tests had been completed?

A. Tests are never considered completed until the final report is published. There is always time to [13-127] do any tests, if you feel they are necessary. So, I didn't see anything unusual about doing tests right up to the last minute.

Q. You didn't consider it unusual to pick out one pair of speakers out of the

25 brands being tested, and subject them to a special test?

A. The Bose was not a standard speaker; so it was an unconventional loudspeaker and required additional testing.

Q. You didn't do that for the Harman Kardon, did you?

A. The Harman Kardon --

Q. Just answer the question. Did you do that for the Harman Kardon, the special test?

A. No, I don't recall a special test of this type with the Harman Kardon.

Q. All right. Now, only you and Mr. Seligson were present and participated in this special test, right?

A. As far as I recall.

* * *

[13-130] Q. Now, I am going to ask you to step down to the easel and draw us a

sketch of the listening room as of the January 23, 1970 test. Can you draw us a rectangle to represent the room and then indicate where the loudspeakers were in it, placing the door toward the bottom of the drawing?

(Witness complies.)

Q. Draw the loudspeakers, please.

(Witness complies.)

Q. Now, you have drawn in purple an outline of a room with a door toward the bottom right-hand corner of the rectangle, plus two five-sided figures to represent the 901 speakers, correct?

A. Correct.

Q. Now would you, with the orange marker, which I hand you, indicate where you and Mr. Seligson were located during the listening test?

A. Well, we didn't stay in one specific location. We moved around the

room, but the central seating position was approximately over here. Then we --

THE COURT: I think it would enable me to take a look, too, if you worked from the [13-131] the other side.

THE WITNESS: This was the central, but we moved the chairs around. We tried listening at different positions.

Q. Did both you and Mr. Seligson wander about the room during the test?

A. Yes, we both walked about the room.

Q. And you have indicated with an orange rectangle what you call the central seating position, right?

A. Right.

Q. Now, during this test of January 23, 1970, did you hear musical instruments played through the 901 speakers which appeared to you to be of physical dimensions greater than the

dimensions of actual instruments?

A. Yes.

Q. Which instruments gave that impression to you?

A. Piano, mainly a piano. The violin actually -- the source of the tones changed with the tones themselves. And whether or not you would construe that as an enlarging of the violin is academic.

Q. During the test on January 23, 1970, did you hear musical instruments played through the Bose 901 speakers which to you appeared to wander about the room?

A. Yes, the violin is the one that shifted.

[13-132] Q. Any others? A. No.

Q. I am going to give you a red marker and ask if you will please indicate on the drawing where the violin

appeared to you to be, and where it moved, if it moved?

(Witness complies.)

Q. You have drawn a red rectangle immediately to the top of the speakers and located between the point of the two speakers?

A. That is correct.

Q. Did the violin appear to you to be as wide as that rectangle you have drawn?

A. Well, it appeared to be as wide as the space between the two loudspeakers.

THE COURT: You mean the violin?

THE WITNESS: The violinist. He asked me to show the range --

THE COURT: What was the space, in your opinion?

THE WITNESS: It is approximately 10 feet or so, I would say.

THE COURT: The violin seemed to be 10 feet long?

THE WITNESS: Approximately; but he [13-133] asked me, you know, show where the notes seemed to travel.

THE COURT: Not the notes, no.

THE WITNESS: Where I heard the reflection.

Q. Where did the violin appear to you to be?

A. It appeared to be at various points in this rectangle.

Q. Within the red rectangle you have drawn? A. That is correct.

THE COURT: What about the sound of the violin, to which you testified? What did they appear to be, the physical size of the violin?

THE WITNESS: The physical size of the violinist, I got the impression that I was up close to the violin, so it would

appear to be a couple of feet, maybe three feet.

THE COURT: Long?

THE WITNESS: Yes, at any particular instant.

THE COURT: In your opinion, how long is the actual size of a violin?

THE WITNESS: I would say it is about --

THE COURT: Three feet?

THE WITNESS: No, I would say it is about [13-134] 15 inches, maybe 18 inches.

Q. You say the violin appears to be two or three feet long?

A. No, I heard this violin's tones come from points in this rectangle. Any particular moment when I heard the violin, it didn't sound 10 feet wide. It sounded something on the order of two to three feet in width.

Q. All right. What was there that enabled you to form an impression about the width of the violin?

A. Just the perception, as I heard the sound.

THE COURT: I have difficulty with that concept. I have heard a violin; we all have. I have difficulty in conceiving of sound which emanates from a violin indicating to me the size of the violin itself.

THE WITNESS: Well, I wasn't listening -- I was listening to a recording of a violin as played back on the Bose. So, that's how I heard it.

THE COURT: You formed a mental image of a violin that was three feet long?

THE WITNESS: I formed the mental image of a larger size violin. That is what I heard.

THE COURT: You see, the difficulty I

have is how anyone can tell the size of a violin, [13-135] the physical size of a violin, from listening to the sound that comes from it.

THE WITNESS: What I was hearing was the physical size of the sound in it that I was hearing.

THE COURT: I am not going to get back to sound image. We are back to sound image which means nothing definite.

THE WITNESS: I perceive the sound as coming from a point that was approximately there.

THE COURT: I heard you say that the first time, but then you asked questions making more specific reference to the size of the physical violin which you thought you heard and you said three feet.

THE WITNESS: Two to three feet, yes.

THE COURT: I say, can you tell the

size of an instrument from the sound that comes from it, the dimensions of an instrument, the physical dimensions of an instrument from the sound, can you tell that?

THE WITNESS: You mean if there was a real violin in the room?

THE COURT: Yes.

THE WITNESS: If there was a real violin [13-136] in the room, you would have some perception of the size of the violin.

THE COURT: Of the actual size?

THE WITNESS: Right.

THE COURT: Now, suppose you couldn't see the violin. You say you actually imagined the physical size of the violin that you were hearing sound from by just listening?

THE WITNESS: One would be inclined to try to imagine the size of the sound

source. Whether you would be successful or not, I don't know.

THE COURT: All right.

Q. (By Mr. Perry) How could you distinguish what you heard on this occasion with respect to the violin, how could you tell or how did you have the impression you were hearing an instrument two or three feet wide moving about, rather than an instrument six inches wide moving about?

A. You are asking me: Did I know that it was a violin or --

THE COURT: No, he didn't ask you that.

THE WITNESS: It is obvious. You can tell a violin from the sound. I am describing the size of the sound as it appeared to me.

THE COURT: No, no, not the size of [13-137] the sound. We are talking about

the size of the instrument from which you heard the sound coming.

THE WITNESS: The sound is as if the violin was two or three feet wide.

Q. What made it sound that way? That is what we can't get.

A. I don't know what made it sound that way.

Q. I mean, what was there about the sound that made you think the violin was wide?

A. The sound seemed to come from this wide an area.

Q. A single note came from that wide an area? A. Yes.

Q. Indicating with your hands about 18 inches apart, when you just held up your hands? Now, you have moved them way out.

A. I wasn't trying to show the size. I was just trying --

THE COURT: Let's go on.

Q. Can you draw for us in blue on this same chart where you thought the piano was located and its dimensions?

A. The piano was approximately almost the same, except that it went beyond the edges of the loudspeaker, somewhere between the edge and the very edge of the room.

[13-138] THE COURT: I notice you keep hovering in the back of the room, but hadn't you testified that you got the impression that the instrument was moving about the room?

THE WITNESS: No, no. I heard the instrument shifting across the wall.

Q. So you didn't hear the instrument wander around the room then?

A. You mean into the room?

Q. Yes.

A. No, I did not hear it wander into

the room.

THE COURT: At any time?

THE WITNESS: No, it did not at any time.

Q. You didn't hear it come out and wander about within the room that you were in?

A. No, I heard it wander about the room, confined on that wall.

Q. Indicating --

THE COURT: How far from the wall, an area how far from the wall?

THE WITNESS: Let me try to answer that. I would say the depth, if you are asking me the depth of the sound image, was about -- well, it seemed -- part of the sound seemed to emanate from behind the wall. In other words, I -- the way I [13-139] have drawn it. I did not hear the sound coming just from the surface of the wall.

THE COURT: How far?

THE WITNESS: It is very hard to say. I would say mentally my image was perceiving it as about three feet, four feet at the most.

THE COURT: Into the room?

THE WITNESS: Well, partly into the room and partly behind the wall.

THE COURT: But the part that seemed to come within the room was occupied in what area of the room; how far from the wall?

THE WITNESS: No more than three feet.

Q. (By Mr. Perry) Well, how far were the speakers from the wall?

A. Well, the apex here is a foot and a half; and then the front of the speaker is about 12 inches or so.

Q. The area that you have drawn within the room where you heard the

violin and piano was between the end wall and the speakers, right, and the back of the speakers, the V of the speakers, isn't that correct?

A. Well, it was not drawn to scale. I was asked how wide the image was. It varies from moment to moment, but it was behind the wall at some depth [13-140] which I didn't observe, and it was forward at some depth which I cannot --

THE COURT: You did. You said it was three feet or it was four feet. Now, which is it?

THE WITNESS: The worst it ever was, the maximum I ever heard was a total depth of about no more than four feet from the wall.

THE COURT: From behind the wall?

THE WITNESS: Part inside, part outside.

THE COURT: How much of it was within

the room or did it --

THE WITNESS: It is very hard to say how much is in the room. I am talking about maybe a couple of feet, maybe less at moments.

Q. Now did you --

THE COURT: How much longer are you going to go on this line? We have had questions along this line a great many times and for a long time. Like everything else, it must come to an end.

MR. PERRY: Unfortunately, we get a different story from each.

THE COURT: That is the best they can do.

MR. PERRY: I will offer this as the [13-141] next plaintiff's exhibit, your Honor.

THE COURT: Have it marked in evidence. Any objection?

MR. BEIL: No, your Honor.

THE COURT: All right. What exhibit?

MR. PERRY: I think it will be 34.

THE CLERK: Plaintiff's Exhibit No. 34.

(Plaintiff's Exhibit 34, chart drawn by Mr. Lefkow, marked in evidence.)

* * *

[13-142] MR. BEIL: Your Honor, one correction. I think that should be Plaintiff's Exhibit 35; 34 was Mr. Florman's drawing.

THE COURT: I have an Exhibit 34 already.

MR. BEIL: That was Mr. Florman's drawing.

MR. PERRY: I guess that is my error. This should be 35, your Honor.

THE COURT: Okay.

(Drawing by Mr. Lefkow, previously marked Plaintiff's Exhibit 34 in evidence, now marked Plaintiff's Exhibit 35 in evidence.)

* * *

[13-153] Q. You testified earlier that the Harman Kardon was not included in the special listening test done on January 23, 1970. Why is that?

A. That special listening test was for the Bose 901. I don't recall -- I don't recall anything specific about the Harman Kardon relative to that test.

* * *

[14-2] DAVID MARVIN GREEN, Sworn

Direct Examination by Mr. Beil

Q. Dr. Green, could you state for the record your name and address, please?

A. David M. Green. The address is 9 Lakeview Terrace, Winchester, Massachusetts.

* * *

[14-3] Q. Dr. Green, where are you currently employed? A. I work as a consultant for Bolt, Beranek & Newman. I also work as a professor of psychophysics at Harvard University. I'm Chairman of the Department of Psychology and Social Relations there.

Q. At Harvard? [14-4] A. At Harvard, yes.

Q. You say you are professor of psychophysics. What is that?

Q. Psychophysics is the study of the relationship between physical stimuli and

people's reactions to those stimuli, responses to such stimuli.

Q. Why is it in the psychology department? A. Well, psychology deals with people in general. An important part in the behavior of people is their reaction to physical stimuli. So actually psychophysics is one of the older parts of the field of psychology. It usually dates from Fechner --

THE COURT: Speak a little more slowly so there will be no question about the testimony being taken down accurately.

THE WITNESS: It dates from Fechner, about the middle of the last century.

Q. What's the relationship between psychoacoustics and psychophysics?

A. Psychoacoustics is a subbranch of psychophysics. It studies a reaction to sound; the physical stimulus involved in

sound, sound waves.

Q. Another way of defining psychophysics is what people hear and how they hear? [14-5] A. What people hear and the mechanism by which they hear it.

Q. What's the relationship between acoustics and psychoacoustics? A. Acoustics is the physics of sound, so it studies the sound wave and how it encounters objects and reflects and that sort of thing. It is a purely physical study and does not involve the human observer.

Q. Psychoacoustics? A. Psychoacoustics is acoustics as it relates to reactions of people hearing sound.

Q. Does psychoacoustics involve the study of both acoustics in physics and psychology? A. Yes, it is a discipline that lies on the border of those two

fields.

* * *

[14-7] Q. Could you now, Dr. Green, summarize briefly your educational background? A. I received a BA from the University of Chicago in 1952; a second BA from the University of Michigan in 1954; Masters from the same institution in '55; a Ph.D. from the University of Michigan also in 1958; then I have two honorary degrees from the University of Cambridge in Cambridge, England, and Harvard University.

THE COURT: You say 1958 for your Doctorate Degree, Ph.D?

THE WITNESS: That's correct.

THE COURT: '58.

MR. BEIL: Your Honor, if it would help I could give you the copy of Exhibit BU which I will ask to be put into evidence. The witness has a copy in

front of him, as do counsel for the plaintiff.

THE COURT: All right.

Q. The BA that you received from Chicago in 1952 -- [14-8] what was the field? A. Liberal Arts.

Q. And the BA from Michigan in '54 -- what was your field of study? A. Field of Psychology, as was the MA and Ph.D.

Q. They are all in Psychology? A. That's right.

Q. And did you do any work in psychoacoustics at Michigan? A. Yes, I conducted research in connection with obtaining my degree. I worked at what was then called the electronic defense group in the engineering department.

Q. Were your Masters thesis and Doctoral dissertation in the area of psychoacoustics? A. They were.

Q. After graduating from Michigan in 1958, could you please tell us now what jobs you took up to the present job?

A. My first was an assistant professor at the Massachusetts Institute of Technology from 1958 to '63. Then I went to the University of Pennsylvania, where I was an associate professor from 1963 to '66. From '66 to '73, I was at the University [14-9] of California, San Diego campus, and from 1973 until the present, I've been at Harvard University. Throughout that period, I've also been a consultant for Bolt, Beranek and Newman.

Q. Starting with your MIT experience, have you taught any courses in psychoacoustics or in physics?

A. In psychoacoustics, generally speaking, I've taught courses in perception at MIT and an introductory psychology course. I can't remember

others I've taught. Essentially the same sort of courses at the University of Pennsylvania and at the University of California; and I presently teach at Harvard a course called -- I think the name of it is Perception. I also teach the pro seminar for the incoming graduate students, professional seminar that is given to all the incoming graduate students.

Q. Does Perception involve hearing? A. Yes, I study both -- I teach both topics in vision and audition in the course of Perception.

Q. Does Harvard have a laboratory of psychoacoustics? A. Yes.

Q. Do you have any connection with that laboratory? A. Well, I guess I would be considered the director. It's a rather small lab, and a few graduate students, [14-10] myself, post-doctoral

Fellows.

Q. Are you a member of any professional societies? A. Yes, I'm a Fellow of the American Psychological Association, a Fellow of the Acoustical Society of America --

THE COURT: Perhaps you should have him specify which of these societies require examinations before admission.

MR. BEIL: All right.

Q. First, let's ask are you a Fellow of any societies? A. Yes, I'm a Fellow of the American Psychological Association, and the Acoustical Society of America and the American Association for the Advancement of Science.

Q. What does it mean to be a Fellow of those societies? A. Well, the procedures differ somewhat. I'm not very sure about the procedures for the latter; but for the first two, as I recall, you

have to be nominated by, I believe, it's a Fellow of the organization and then -- I can speak more directly about the Acoustical Society.

Q. Why don't you do that? A. There are two supporting letters that are required that go to the nomination committee. They make recommendation to the Acoustical Society of America. [14-11] Then if they approve it, a person is a Fellow.

Q. One can't apply to be a Fellow? It has to be selected? A. That's right.

Q. But a Fellow is a more honorary designation? A. Oh, yes. You can be a member of a society.

Q. Have you received any professional honors for your work in the area of psychoacoustics? A. In 1966, I received a Biennial Award of the Acoustical Society of America.

Q. What is that award given for? A. It's given every other year for an outstanding contribution by a person under 35, I believe, is the age limit.

Q. Anything else besides the Acoustical Society of America Biennial Award? A. I received a Guggenheim Fellowship in 1973 and was elected Overseas Fellow in Cambridge, University of Cambridge, England; and in 1978, I was elected to National Academy of Sciences.

Q. Would you tell us what is the National Academy of Sciences? A. It's a private organization that serves as advisory [14-12] and report-generating capacity for the United States government. It comprises about, I think, the membership is now about 1100 people.

Q. How old is the organization? A. I'm not absolutely sure. It's probably at least 200 years old.

Q. How does one become a member of the National Academy of Sciences? A. Well, again, I think you are initially nominated by someone in the Academy; and then there is a series of votes that are taken through the years, during the year, that pare the list down until, oh, usually about 20, 25 people are admitted each year.

Q. Is it fair to say that 1100 members of the National Academy of Sciences are considered to be the top scientists in the country? A. I suppose they think so. Occasionally we make some mistakes, but we tend to get people that are pretty good, yes.

* * *

[14-14] Q. How many psychoacousticians are members of the National Academy of Sciences? A. Psychoacousticians?

Q. Yes. A. Well, broadly defined,

it would probably be Dr. Neff, Indiana; Dr. Calambos, at the University of San Diego; Dr. Hirsch, Central Institute of the Deaf, St. Louis; and myself.

Q. How many psychologists are members of the National Academy? A. I think in the section I'm in, 25.

Q. Of all the academic psychologists in the country, there are only 25 people? A. That's right.

Q. Have you done any other professional work involved in professional publications or journals in the field of psychoacoustics, psychology? A. I'm not sure I understand the question.

Q. Well, have you served on any committees, been associated with any journals, or done any other similar work in the field of psychoacoustics? A. Associate editor of the Journal of the

Acoustical Society of America from 1970 to '73, and I'm consultant for a variety of psychological [14-15] publications.

Q. Have you done any work for the National Research Council? A. Yes.

Q. Could you tell us what the National Research Council is and what it does?

A. The National Research Council is an arm of the National Academy, and it appoints committees that consult and advise on various problems for sponsoring agencies; Army, Navy, Air Force, EPA; National Institute of Health; National Science Foundation; and the like. Transportation, Department of Transportation is another sponsor. They set up, in response to problems posed by these organiztaions, they set up committees that investigate the various -- try to make recommendations on

these problems. It's been a committee in existence for about 25 years, throughout during the war.

Q. Are you a member of any committees of the National Research Council?

A. I was a member of the Committee on Hearing Biological Acoustics and Biomechanics called CHABA. I was on the Executive Committee, two terms, '68 to '71 -- I was Chairman the last [14-16] year -- and it must be '76 to '79, and I was Chairman the last year of that term as well.

Q. Have you published in the field of psychoacoustics? A. Yes, that would be the majority of my publications.

Q. Do the publications listed on Defendant's Exhibit BU comprise all of your academic publications? A. I think so. I may have left out one or two.

I've never gone through it that carefully. I think I have most of them. I tried to put them down.

MR. BEIL: Your Honor, rather than go through the list, I would simply since the list is at least 87 publications, 87 articles and books and six letters to the editor, academic letters to the editor, I would simply like to have Defendant's Exhibit BU introduced in evidence as a list of Dr. Green's publications.

THE COURT: Any objection?

MR. PERRY: No, your Honor.

THE COURT: Admitted.

(Defendant's Exhibit BU, formerly marked for identification, admitted into evidence.)

Q. You published a text or textbook in the field of hearing or psychoacoustics? [14-17] A. Yes, I have. It's called An Introduction to Hearing.

Q. I am holding for you a copy of that? A. That's correct.

Q. Is this book listed in your vitae, which is Defendant's Exhibit BU? A. I hope so. Yes, it's number 66.

THE COURT: What's the title of it?

MR. BEIL: An Introduction to Hearing, by David M. Green.

THE COURT: Does that cover the psychological aspects of the sense of hearing?

THE WITNESS: Both physiological and psychological.

Q. Have you done any work, Dr. Green, in the field of design of loudspeakers? A. No, I have not.

Q. Have you conducted experiments using loudspeakers? A. On occasion.

Q. In the course of your work, have you conducted experiments on what people hear? A. Yes, that's mainly what I do.

Q. And of course, in some of those experiments you have used loudspeakers?

A. Yes.

* * *

[14-105] Q. When you say "back in that position," that is the one that is connected by the dotted line?

A. By the dotted line, and that speaker is not there. It is as if that speaker were there. So we can talk about reflection as generating virtual sources. What I want to do next is talk about the wall in back of the Bose speaker, and I'm going [14-106] draw speakers in back of that wall. They would be virtual sources from the viewpoint of the observer. Now, if I may continue, I'll label this. In my analysis, what is happening with the Bose speaker is that eight times as much energy is directed at the back of the speaker as at the front. By virtue of

that, the reflected energy is some almost eight times as great. That is, practically all of it comes off the back wall, 95 percent comes off the back wall. And the observer's faced with the situation in which -- let's see if I can draw what we use as a Bose speaker. This is the Bose speaker, and that is the observer. These reflected paths are in effect virtual sources here for loudspeakers that have considerably more volume than the direct path created by the Bose speaker in the center of the loudspeaker. There are also paths in this direction.

Q. That is reflected off of two walls?

A. Reflected off of two walls. These will arrive as reflected waves. This will in this case be a virtual source located back here. So the

observer in the situation faces a complicated situation in which there are many speakers. And the reason that these [14-107] multiple speakers are actually observed or play a role in localizing the sound is because the Bose speaker in effect violates the law of first wave form. This energy on this direct path is so small compared with the reflected energy that the observer is confused as to the locus of the speaker. He has to then make some compromise among these multiple reflected paths and determine something about the apparent locus of the speaker. Unless the two speakers are exactly the same, that is their frequency response of the loudspeaker, the polar radiation pattern of the speaker, the way in which it broadcasts sounds off the back and, indeed, the geometry of the room has to be -- if that is in any way

asymmetric, then the apparent locus of the source will depend upon the frequency. So as you play a passage of music, as the music changes in frequency, so will the apparent locus of the source. And in this situation, where you have violated the law of the first arrival, that is the first arrival is considerably down compared with the reflected energy that comes in later, you are liable to have ambiguity and uncertainty as to where the source is. And I would suggest that that [14-108] is the reason the subjects report a variety of things in listening to the Bose speaker. First of all, its image is large because the reflection can come from any place on the back wall. It's hard to say exactly where the source is located because it changes as the function of frequency, and all of this would lead to reports of a

widening image and a sound source that appears to move from one side to another.

Q. Would these effects occur with a conventional loudspeaker?

A. No, the conventional loudspeaker is designed to avoid this problem. The direct path is the only path. That is, the direct path is by far the strongest path. Usually, there are reflections, but there are seldom many. It would be a very rare event for the reflected paths in the conventional speaker to be louder than the direct path. The direct path is the first arriving wave form. It is the loudest wave form and, therefore, localized very precisely. Any asymmetries in a conventional speaker does not affect -- well, it will tend to affect when these direct paths arrive, but they will -- in a conventional speaker, you'll still [14-109] resolve

the source as something in the middle of an array. With the Bose, any asymmetries will change the locus of the secondary echoes, which are much larger than the primary or direct path; and they will change with frequency due to these asymmetries that I have listed.

Q. Could you list the asymmetries for us?

A. The difference in the frequency response of the speaker. Now, that, of course, would -- I'll let it go at that. The differences in the pattern of sound radiation, the polar plots of the speakers, the differences in the geometry of the room, the asymmetries in the room would cause some of these reflections to be larger than others, and for them to be frequency dependent.

Q. Would you expect these asymmetries to be present in a typical

listening room? A. Yes, unless the listening room were extremely symmetric, it would be very rare indeed for the listening room not to be somewhat asymmetric.

Q. Would it -- what effect would it have if the source being played through the Bose 901 speakers were from a monaural record as opposed to a stereo record?

[14-110] A. It might change it to some degree, but the same factors, the very broad image, would be present with a monaural record or a stereo record, or there might be a little more motion with a stereo record. But there would certainly be a lot of motion with the monaural record. And I have listened to monaural records through the Bose, and it's still a wide image and difficult to localize exactly where the sound is.

Q. You have listened to the stereo record? A. Yes.

Q. And what have you heard? A. I have heard things that I would describe as, first of all, as very broad image. There is no question about that. Secondly, the source is hard to localize. It's vague, and from moment to moment changes its location. So you might, especially on solo instruments, the apparent source moves from time to time. It could be located in any number of places in front of you.

Q. Is there any support in the literature for the analysis you have drawn today?

A. Yes. After making this analysis, I then consulted the literature, several journals in the field, and tried to see if anyone else had described loudspeakers [14-111] in this way or described any of

the phenomenon I have reported in this way. And if I may, I could cite some of those references, if you'd like.

* * *

[14-113] Q. Are there any sections of Mr. Bauer's article that you [14-114] wish to refer to specifically?

A. Yes, on the first page, second column, about half-way down, the sentence,

> "As the observer moves from the center, the image will undergo a very rapid motion in the same direction."

And then further down the page,

> "A listener at a live orchestral performance perceives sounds from the instrumental groups directly, which helps to localize the sources of sound. Shortly thereafter he receives the reflected sounds from the ceiling, walls, et cetera, which account for the feeling of being in a large hall."

So again, I point to the importance of the arrival of the first wave form as

localizing the sound, whereas the second or reflecting sound in a conventional situation simply adds quality to that perception. The important point is that the first wave form, if it is indeed as large or larger than the reflections serves to pinpoint the locus of the source.

[14-115] Q. Does that happen with the Bose 901? A. In the Bose, I would argue that the reflected sound is more powerful than the direct sound, and this leads to these anomalies in localization which most observers report.

* * *

[14-123] Q. And in addition to what you have testified to so far concerning your review of the literature and your analysis; is there anything else you have done or caused to be done which forms the basis of your opinion? A. Very much so.

Q. Would you please tell us what that is? A. I set up a listening experiment in which I had subjects compare conventional loudspeaker systems and a Bose 701.

Q. 901? A. I'm sorry, 901. In a small conference room at Bolt, Beranek and Newman, the speakers were both driven by the same electronic equipment, and the passage played was a flute record. The situation was arranged so that we could switch between the conventional systems and the Bose 901. I had the subjects come in and listen for four minutes during which time we alternately presented one or the other systems back and forth for about 30 seconds. This was in -- this was designed to insure them to have some general impression as to how the two systems sounded. And there was a one-minute presentation of one of the

systems, and the subject was at the end of that one minute of listening, was asked to [14-124] judge the spatial extent of the speaker and was asked to mark on a drawing of the experimental room where he thought that speaker was located, as to the special instructions that --

* * *

[14-130] THE WITNESS: Can I continue? They are seated in front of a -- I can't think of the word -- a curtain, burlap curtain.

THE COURT: A screen?

THE WITNESS: Yes, so that they [14-131] can't see the speakers. And we asked them to make a drawing to indicate the size of that image on a drawing of the curtain, after the experiment is done, and then to indicate the area of that image in square meters. So they

give a numerical estimate, and they also make a drawing, and we have scored both of these responses in the course of this experiment.

Q. I refer your attention to the last page of Exhibit CB; would you tell us what that is and what the people who participated in this listening test were supposed to do with regard to that page?

A. That is a sketch of the front wall elevation which is primarily that burlap screen, and that is a post over on the right. That is the one line on the right, and that is a front wall elevation, and then there is also a plan view of the scene looking down on the room, and the position of the two subjects that ran in, that were involved in the experiment at any one time is indicated by the desk and the chair where the subject sat in approximately the

middle of the room, midway between the speakers.

Q. What were the participants supposed to do with respect to this drawing?

A. Well, at the conclusion of the first minute segment [14-132] with one of the speaker systems being played, they were to indicate numerically how large the image source was in square meters, and to draw it on the front elevation and to sketch its depth on the plan view. Then for the next -- then the next minute, they heard the other system and were required to make the same judgment of the other system. So we were comparing the two systems. Sometimes they were run in one order; sometimes in another.

THE COURT: Aren't the limits or the boundaries of this so-called image rather

vague and impossible of exact determination?

THE WITNESS: That was the complaint of many of the subjects, that some of the images were very difficult, too.

THE COURT: Are there any images when you speak of sound as an image? Can there be any image which has an exact contour?

THE WITNESS: They drew these contours on the page for me.

THE COURT: I know they drew it, but how can you conceive of a definite boundary of such an image in space? Certainly the sound itself doesn't have a short little pattern around it.

[14-133] THE WITNESS: No, there would be borders, and I think I can get your Honor's puzzlement if we can get to the data. I think what that will do is some subjects will take a very restrictive

definition of what they mean by shape and therefore they'll tend to draw very small pictures. Others will take a more liberal definition and therefore draw very large pictures.

THE COURT: That being the case, how can you know whether or not you are giving an exact data?

THE WITNESS: Well, your Honor, the purpose is to compare these two systems. And you see, if the person who has a very restrictive definition draws a very small image for one and a larger image for the second one, and the other person who has a very liberal image and draws a picture this size for the first and that for the second; in both cases, I'm safe in concluding that the second system appears bigger than the first system. That is the purpose of the experiment. I want to determine in a few days exactly what the

subject means when he talks about a sonic image or the extent of a sonic image. What I'm trying to do is compare two systems, and [14-134] see if one is reliably larger than the other in their apparent sonic image.

Q. Where did this experiment take place? A. Bolt, Beranek and Newman, in a conference room on the third floor of the new building. I should point out, I haven't concluded the experimental manipulations.

Q. Why don't you continue with that?

A. There were two other parts of the experiment. Another two minutes of sound were played. In these, I asked the subjects to indicate the extent of the motion of the image. Next, the judgment -- once the judgments of extent are completed we will next judge whether or not the apparent sound source changes

location and if so by how much. They hear a one minute musical passage. During that minute they listen carefully and note the apparent position of the sound image. Once again they project the image on the front wall, connect the centers of the two most distant locations and estimate the length, in meters, on a line connecting these two points. To help them make an accurate judgment of length, we placed a white string one meter long in front of them on the curtain. And then they're asked, of [14-135] course, to draw the approximate locations so that we can inspect where the image appeared to be and correlate the drawing with the judged extent -- judged motion.

Q. How long was the segment of music that they listened to?

A. One minute, and they listened

again to one of the systems and made the judgment. Then they listened another minute and made the judgment for the second, and that concluded it. So that they made a judgment of extent and made a judgment of motion for the two systems, the Bose 901 and the conventional system.

* * *

[14-136] Q. How many subjects were involved? A. We ran eight subjects each day, 16 subjects total.

Q. Did you design this experiment? A. Oh, I guess you could say that. Yes.

Q. Who conducted it? A. The subjects were actually run by Dr. Sheldon, who was the postdoctoral fellow who is working in my lab. I was the -- well, I helped set it up and went [14-137] through a dry run with him and then was present for a couple of tests, but not for the entire duration.

* * *

[14-138] Q. Did you give an instruction to Mr. Sheldon as to whether the listeners were to be allowed to see the speakers or not?

A. Certainly, that was part of the purpose of the experiment there was to conceal the speakers from the subjects so that the lights were not turned on in back of the curtain. I instructed Dr. Sheldon not to turn the lights on in back of the curtain. That is what I know.

Q. Now, where did the subjects come from? A. They were volunteers that we had.

Q. Were any of them employees of Consumers Union or Bose Corporation?

[14-139] A. No.

* * *

[14-145] THE COURT: Who participated in this experiment?

THE WITNESS: Volunteers at Bolt, Beranek and Newman.

THE COURT: Who were they? Do you know who they were? How many were there and who were they?

THE WITNESS: Sixteen, and they were all employees of BB&N. I can name some of the names. I doubt if I could generate all 16.

THE COURT: Did you take steps to have them identified?

THE WITNESS: Yes, I know who they all are.

* * *

[15-32] Q. Could you tell us what Page 2 [of Ex. CF] represents and how it should be interpreted?

A. You will recall in the experiment, the second judgment [15-33] given by the subject was the extent of movement of the source. Again, source,

system A and system B were played, and the subject judged the extent that the instruments seemed to move around during the passage that they listened to.

THE COURT: With reference to some specific point in the room or what?

THE WITNESS: No, they were asked to try to figure out where the flute was as the passage began; and if it moved at all, to note how it moved and then finally judge the farthest two points that the flute ever occupied during the one-minute passage. The judgment was made in meters. The values indicated opposite the entries, S-1 under systems, System A and System B, are the extent of that judgment in meters. So the first subject, for example, said System A moved during this minute a half meter. He said System B moved one meter. Again, as with previous comparison, I would urge you to

look at the ratio of the judgments. If the judged movement is greater for System B than A, we put a plus sign in the last column. If it's the opposite, we put a minus sign. There is [15-34] no sign indicated for Subject 12 because he didn't believe that either system moved. The test was constructed so that that was an allowable response, and that subject made that response. Many subjects, for example, Subject 3, Subject 7, Subject 12 -- I'm sorry -- Subject 15 said that the conventional system did not move at all, but the Bose system moved a certain amount; 1.7, 3, and 1 meters. Again, we can consider whether or not the subjects are able to make this judgment reliably by asking whether the ratio predominantly in one direction or another -- again, it is 13 positive, two negative, one tie, we don't count. It probably in this case of

that result arising by chance alone is five parts in a thousand. If you look under the regression column, again, you see the movement is about 2.48, 2.5. The ratio is about 2.5 between the two systems; that is, the Bose system appears to move more than a conventional system. The flute, when listened to through the Bose system, appears to move more than under a conventional system. That's all I wish to say in summary of that.

* * *

[15-37] Q. Turn now to the last page of this document, if you would.

A. Again, after the movement judgment, the extent of movement judgment had been made, the subjects drew dots or small circles on the page indicating where the instruments had seemed to be in the course of this one-minute passage, and we simply took a ruler out and drew a

line connecting the furthest points and estimated, therefore, from their drawings the extent of the movement; and those numbers are represented in this page so that, for example, Subject 1 the apparent motion inferred from a measurement with a ruler on his drawing was about .77 meters. [15-38] Again, the pattern of results is similar to what we have seen before. In this case there are 13 instances in which the subject judged the Bose to move -- drew pictures in which the Bose appeared to move further than the conventional Altec system. In one case, the reverse occurred. The probability associated with this ratio is 2 parts in a thousand. If these systems were judged to be equal in the extent of motion, the chances of this particular configuration of results happening would be 2 parts in a thousand. Again, the

regression analysis shows that the motion of the Bose as inferred from these drawings is about two times what the motion of the conventional system as inferred from the same drawings, the drawings for the conventional system.

Q. Can you draw, or did you draw, any overall conclusions from the data that you accumulated during this experiment?

A. I think the experiment demonstrated what I had observed personally; namely that the size of the acoustic image produced by the Bose system is considerably larger than that produced by the conventional system. The positions of the [15-39] instruments and their apparent motion is also greater for the Bose than for a conventional system, and this ratio runs between two and three, depending upon subjects. Not all

subjects see it this way, but the overwhelming majority --

Q. Okay. A. I should say, hear it, rather than see it. Hear it this way.

* * *

Q. Your testimony today, Dr. Green, is a continuation of your testimony yesterday as to what the bases of your opinion are. Did your personal observations form part of the basis of your opinion?

A. Yes, my personal observations formed part of the basis of my opinion. [15-40] The analysis of the relevant scientific literature was the other basis for my opinion, and the results of this experiment all support two essential features, I think, in summary. One is that the image is larger with the Bose than with conventional systems and that the locus of the image is somewhat -- I

would describe it as more unstable. It appears to move from time to time more than does the same acoustic image that is heard through a conventional speaker.

Q. Could you tell us, describe what personal listening you did to the Bose 901.

A. It's described somewhat in the letter that I wrote, but I spent approximately six to 10 hours, I would estimate, over a period of a couple of weeks listening to the system. I played a variety of different kinds of music, singing, human voice, harpsichord music, piano music; and in all cases, -- some recordings of calliope. In all cases, it seemed that the same conclusions, general conclusions, could be drawn. Some pieces of music exemplified [15-41] what I've stated more than others; but in all cases, the image was larger, the image

was less stable and appeared to move from time to time.

Q. By the way, did Consumers Union tell you how to design or conduct this experiment that you have described for us today? A. No.

Q. Who designed it? A. I designed it.

Q. Did Consumers Union tell you which music to use? A. No, I selected that passage myself.

* * *

[15-56] Q. Dr. Green, what phrase or term is used in the term of psychophysics, psychoacoustics, to refer to the nature or the dimensions of sound produced by a sound-producing object or instrument?

A. The apparent size of the source.

Q. All right. Based upon your knowledge of psychoacoustics,

psychophysics, based upon your personal observations of the Bose 901 and of the tests and experiment that you conducted and described for us, were you able to form an opinion concerning the [15-57] apparent size of the source of the sound produced by the Bose 901 loudspeaker system?

A. Yes, I was.

Q. Could you tell us what that opinion was?

THE COURT: What's the answer?

THE WITNESS: Yes, I was.

* * *

[15-59] Q. Could you please now answer the question.

A. "In comparing the Bose 901 with a conventional loudspeaker system, I observed that the conventional system provides a more restricted sound image than the Bose and one in which the

individual instruments tend to stay in the same location. The Bose 901 system produced a much wider and more diffuse sound image. On some solo passages played through the Bose 901, the location of the musical instruments is very indistinct and [15-60] may be localized in different places in the listening room at different times." Let me add to that, since the term "sound image" appears in that passage I would, in view of the discussion we have had on it and the fact that it is not precisely defined, I would substitute -- well, let me put it this way. I mean by sound image --

THE COURT: So as to shorten this thing and retain the accuracy that you are striving for, why don't you make the changes you think you should make and read it as changed.

THE WITNESS: Thank you, your Honor.

(Pause.)

THE WITNESS: I think I'm ready, your Honor.

THE COURT: Ready? All right.

THE WITNESS: "In comparing the Bose 901 with a conventional loudspeaker system, I observed that the conventional system produced an acoustic image of smaller apparent size than the Bose and one in which the location of the individual instruments tended to stay in the same location" -- I beg your pardon -- "tended to stay in the same location. The Bose 901 system produced an image [15-61] of much wider and more diffuse apparent size. On solo passages played through the Bose 901, the locations of the musical instrument is very indistinct and may be localized in different places in the listening room at different times."

* * *

Q. Were you also able to form an opinion concerning the apparent movement of the source of sound produced by the Bose 901 loudspeaker system?

A. I take statements about the movement to indicate the change in location as a function of time, and the statement indicates that there are these changes of location. [15-62] The phrase "movement" to me -- I find a little difficulty interpreting statements of motion in the following sense: I don't appreciate the solo instrument, for example, the flute or violin, as being united in one place and then slowly progressing over to another place. Rather, I find the image of the instrument to be fleeting and first in one place and then in another.

THE COURT: To be what?

THE WITNESS: Fleeting.

THE COURT: Fleeting?

THE WITNESS: First in one place, then in another. So that as I say, the apparent locus of the instrument changes from time to time.

* * *

[15-74] Q. Dr. Green, do you have an opinion concerning whether the location of individual instruments when played through the Bose 901 loudspeaker system appear to change or to move? A. I do.

Q. Could you tell us what your opinion is and what that opinion is based upon?

A. The location of any instrument played through the Bose, as the range of music changes, that is the frequency composition of the passage changes, appears to occupy different points at different times. The image is somewhat

indistinct and those two may be related in some way, but the actual location, for example, of the flute or the violin seems to move or occupy different positions at different times. And the basis of that opinion is my own listening, the subjects -- reports from [15-75] the subjects that ran in the experiment, and I find it consistent with the physical analysis of the Bose 901 that I gave yesterday.

* * *

[15-76] Q. Dr. Green, if you draw a line between the speakers, with respect to that plane on which the speakers are, do you have an opinion whether there is any -- whether this movement is either forward or back of this line? A. Yes.

Q. What is your opinion?

A. There is an apparent change in the distance from the observer to, say, the plane running through the two

speakers, and that changes at different times as [15-77] well. Sometimes the instruments would seem behind the wall of the listening room, sometimes in front of the listening room. To my own ear, that change was not very marked, and it was confined roughly to this area that Mr. Seligson has testified about and Mr. Lefkow. But our subjects report considerable changes in depth.

Q. Were there any such reports during your experiment?

A. I think you will find one of the subjects in the experiment drew a picture in which the -- if we look down on the room from above, it is at least behind the curtain and well out into the side of the room, but his or her ear -- I'm not sure of the sex of the subject.

* * *

[16-22] Continued Cross-examination by Mr. Perry

* * *

[16-96] Q. When you were playing the Bose 901 on March 14, did you ever have the impression that musical instruments were growing to gigantic proportions and coming out and wandering about the room?

A. I wouldn't use that language.

* * *

[16-129] Now, you told us at the end of the day yesterday, Dr. Green, that the subjects who were tested on March 18 and 19 reported perceiving a movement of the sound source in the case of both the Altec conventional speaker and the Bose 901 speaker; that is correct, isn't it?

A. That is correct.

[16-130] Q. And you said that you expected that, right? A. I did.

Q. Why? A. Well, the material they

were listening to was a stereo recording; and in the course of any, practically any stereo recording, there will be a loudness change in the two speakers. Therefore, the image will shift back and forth between the two speakers; not to the speakers, but in the direction of the loudspeaker in the course of the passage.

Q. That happens with conventional speakers as well as speakers like the Bose 901, doesn't it?

A. That's true. One of the quotes I read into the record, the first part of my testimony, in fact, commented on that same problem with conventional speakers.

Q. So a certain amount of movement or apparent movement of the sound source in the plane of the speakers is to be expected, whether the speakers are conventional or Bose 901s, correct?

A. That is correct. Not everyone

hears it. Some of my subjects said no movement. But I would say on average, that's the case.

Q. Would you agree that the average person hearing that [16-131] apparent movement does not form a mental impression that the instrument being played is moving about?

A. My data seemed to indicate that he does.

* * *

[16-134] Q. No. Neither would anybody else of normal hearing, would he?

A. Well, there is a great range of descriptors that people use in describing these experiences, and I wouldn't use the term "an instrument moves about;" but I would not be surprised if somebody else would. Nor would I expect them to really think that an actual instrument is moving about or something. It would be simply

as a descriptive phrase for the apparent movement of the instrument being played.

* * *

[16-151] THE COURT: Let's make sure. Show it to him. It's 11.

THE WITNESS: Well, I would interpret the maximum motion, which was part of the instructions, to be from this point, that is, a point behind her head, almost directly behind her head, to the left-hand corner of the room; that is, that the maximum motion was a motion was a motion in depth of approximately 13 meters. Then we asked if it ever arrived at any other place, indicate that on the drawing. She apparently did so. If we project across the front of the wall, you get a lateral motion of about five or six meters.

* * *

[16-178] Q. All right. Turning to

Page 1, second paragraph of your letter, the last sentence says: "I have also relevant technical literature in this field." What did you mean by the words "this field"?

A. I'm sorry. I lost the page.

Q. The first page, second paragraph, the last sentence. What did you mean by "this field"?

A. Binaural hearing, localization, lateralization.

Q. And did you in fact make an extensive examination of scientific literature in that field? A. I did.

Q. Are you aware of any publication in the scientific [16-179] literature -- I don't mean popular magazines, but the scientific literature -- that describes the phenomenon of a loudspeaker causing a musical instrument to appear to have greater dimensions than the dimensions of

the actual instrument? If you want that read back, perhaps we should.

(Question read back by the reporter.)

MR. BEIL: We want to first establish what you mean by scientific and popular literature.

THE COURT: I think it's clear enough. Do you understand the question?

THE WITNESS: I believe so.

THE COURT: Is there any word in it which is not clear to you?

THE WITNESS: Could you read it back one more time?

(Question read back by the reporter.)

THE WITNESS: I could not cite such reference. I don't know of any.

Q. Are you aware of any description in the published scientific literature of the phenomenon of a loudspeaker causing a musical instrument to appear to move away

from the location of the loudspeaker and to wander about the interior of the room in which the loudspeaker [16-180] was played?

A. Again, the language is critical, so could you read it back?

(Question read back by the reporter.)

THE WITNESS: I'd have to consult some of the quotes that I read in the record earlier. They would be in my other book, if I can refresh my recollection. I'm not sure whether they contain such descriptions or not. This is not a sort of description that would appear in scientific literature.

Q. Assuming that those quotes do not contain such a description, what would your answer be?

MR. BEIL: Your Honor, that assumes -- I don't know if it's warranted or not.

MR. PERRY: I know there is no such description in any of the scientific literature in the quotes he's read to us.

THE COURT: What's wrong with the question?

MR. BEIL: He is making an assumption that is based entirely on Mr. Perry's --

THE COURT: Read the question.

(Question read back by the reporter.)

MR. BEIL: Assuming that those [16-181] articles do not contain such quotes.

THE COURT: Then you make such an assumption.

THE WITNESS: Do you want my answer if I --

THE COURT: Can you make such an assumption? Is it too difficult?

THE WITNESS: I think I understand the question. If I assume that those

quotes do not say that, then I know of no other quotes that would say that.

* * *

[18-25] Q. I think you testified last Friday, Doctor, that you would [18-26] not use the language, "instruments appeared to grow to gigantic proportions and tended to wander about the room," to describe anything which you have heard personally in listening to the Bose 901 loudspeakers, is that correct?

A. That is correct. I would not use that language.

Q. And you testified, if I recall correctly, that you thought a layman might use such language?

A. I can -- it's perfectly conceivable that given a situation where the image is somewhat diffuse that that could be described that way.

Q. In fact, to quote you exactly, at

Page 17-64, you said: "I can well imagine some ordinary person, layman, a subject being confused about it and discerning it as if the instrument itself had grown." Do you remember that?

A. I think I would agree with that, at least use those words.

Q. When you used the term: "layman," did you mean someone who was inexperienced and unsophisticated in the testing and evaluation of loudspeakers? A. Yes.

Q. Dr. Green, if a person had a degree in electrical engineering and had taken postgraduate courses in acoustics and engineering, working towards a masters [18-27] degree, and had worked for more than 15 years in the testing and evaluation of loudspeakers and other audio products, and was in charge of testing loudspeakers for a national

consumer product testing organization, and was able to design and conduct and supervise tests to evaluate loudspeakers, and himself had invented a loudspeaker on which he had received a patent, would you consider such a person to be a "layman," within your meaning of the word?

A. No, sir.

* * *

[18-29] Q. While you were listening to the Bose 901 loudspeaker, did you perceive at any time that an instrument seemed to move out away from the plane of the loudspeakers and into the room?

A. No, sir.

Q. How many hours did you spend listening to the Bose 901 system?

A. Approximately, oh, approximately 16 to 24 hours, somewhere [18-30] in that range.

Q. Prior to the time you were

contacted about being an expert witness in this case, on February 15 of 1980, had you ever listened to Bose 901 loudspeakers? A. Yes, sir.

Q. Under what circumstances?

A. My memory is not very clear, but it must have been about the time the speakers were produced, I heard them played in a hi-fi store in Pacific Beach in California.

Q. For how long a period? How long did you listen to them? A. Fifteen minutes, perhaps, half an hour.

* * *

[18-33] Q. Let me ask, Dr. Green, as you listened to the Bose 901 loudspeakers in preparation for testifying here, did you sometimes think that notes from the same instrument came from different directions as the frequency of the notes changed?

A. That was my impression, yes.

Q. And you would expect that to happen with conventional speakers as well as Bose 901 speakers, wouldn't you?

A. Conventional speakers pointed at the wall or facing --

Q. No, the conventional speakers with the drivers on the front, pointing toward the listener?

A. No, I don't think I would.

Q. Let me call your attention, Doctor, to a portion of your testimony on the 15th day of trial, at Page 15-147, the last question and answer on the page. If you would read that to yourself. You testified there, didn't you, that with conventional speakers, you would expect some movement [18-34] of the apparent location of the sound source.

MR. BEIL: The testimony stands for what it says. The question you're asking

today is slightly different.

Q. Well, I'll take it a step at a time. With conventional loudspeakers, that is, having the drivers only on the front, and pointed toward the listener, not toward the wall, you would expect, as you listened to notes of different frequency, that the direction from which a particular note came might change with frequency, isn't that true?

A. Is this a single speaker or a stereo, a pair of speakers?

Q. A pair of speakers. A. A pair of speakers?

Q. Yes. A. Well, on a pair of speakers, the image might shift a little between the two, even with conventional speakers.

Q. As the frequency changed, right? A. It could, or it could be in the program material itself, that there were

just, the sound is louder on the right than on the left at some particular passages.

[18-35] Q. All right. In either case, you would expect some apparent movement of the location of the direction from which a particular note came, either as the intensity of the music changed between the left and right speakers or as the frequency of the note changed, is that correct?

A. That is correct.

Q. Both with the 901 and with the conventional speaker, right? A. With both systems, yes.

Q. I may have asked you this, and if I'm repeating myself, I apologize but while you were listening to the 901 speakers, you never got the impression of the speaker coming out from the area of the plane and coming in toward you, did

you?

A. My listening, no.

* * *

[18-94] REDIRECT EXAMINATION by Mr. Beil

* * *

[18-108] Q. (By Mr. Beil) Dr. Green, you have listened to the Bose 901 loudspeaker and you have conducted tests upon it. What, in your view, is the most noticeable difference between the sound of solo instruments when played through the Bose 901 compared with the solo instruments being played through a conventional speaker system?

A. The most salient characteristics, in my opinion, ones that would be noted especially in a comparison between the conventional and the Bose, is the size of the acoustical image, where the sound appears to come from, in the two situations; and whether the stability of

the image, as to whether it stays in one place or appears to move about, comes from different [18-109] places at different times.

* * *

[18-111] THE COURT: What is meant by the size of an acoustic image?

THE WITNESS: Well, it's essentially in a report by the subject of what the subject believes the area of the object making the sound is, the extent of the object.

THE COURT: Well, the object that makes the sound, in the case where we have a loudspeaker, is a loudspeaker.

THE WITNESS: That's correct.

THE COURT: Well, the size of that loudspeaker is ascertainable by looking at it.

[18-112] THE WITNESS: That's correct. But you will recall that if we have --

THE COURT: I'm talking about acoustic image.

THE WITNESS: Yes, but you recall that in the Gardner article, it described the situation where you have two loudspeakers at about 45 degrees with respect to the listener, and the subjects will report that the sound appears to come from an area in front of them and that area has some extent.

THE COURT: That I understand. The area from which the sound seems to emanate is susceptible of some estimate, that's true. But is that synonymous with image?

THE WITNESS: That's the way I use the words "apparent acoustic image." If you ask the subject to draw how large the sound is, I would take that drawing --

THE COURT: Meaning the area of what?

THE WITNESS: The area as he drew it

on the paper. I could translate it into the room if I know the dimensions of the screen or the curtain he was looking at.

THE COURT: What is he supposed to visualize in his mind, for this sound image; sort of [18-113] a mass, a shapeless mass?

THE WITNESS: I think that's about as best as I can describe it to you, yes.

THE COURT: So I wasn't too far wrong in thinking that was what you talked about?

THE WITNESS: That is what is being talked about.

THE COURT: That is very vague, isn't it?

THE WITNESS: Yes. It's difficult to get precise definitions and concepts in this area.

* * *

[18-116] Q. Is the language quoted to

you by Judge Julian, instruments appearing to be of gigantic proportions and tending to wander about the room, within the range of responses reported to you by the experiments, by the subjects in your experiments?

[18-117] Q. Is the language quoted to you by Judge Julian, in your view, misleading or inaccurate?

A. I wouldn't say so, no.

Q. Why not?

A. Well, one accepts a considerable variability in the way people describe these situations. They are not concrete and very definite. There is a degree of vagueness in your characterization; and I would -- well when they draw pictures where the source comes out of the room and is in back of them in the course of listening to the passages, I would say that indicates a great deal of movement.

Whether you want to call it wandering or not, I prefer not to try to settle that issue. But they certainly show a lot of movement and a great deal of size. One of the subjects, for example, drew essentially the entire curtain in front of her, 13 square meters, as being the apparent source of the sound when listening to the Bose 901. Now, that is not the size of the flute. It couldn't be the size of a flute under any stretch of the imagination. So it would -- it's an unusual experience, and how they care to describe those [18-118] unusual experiences, I really can't control and I don't try to. I just listen to their descriptions and try to interpret what they are saying in terms of the physical stimulus.

* * * *

[18-125] You testified on cross that you

listened to the speakers in California when they first came out, the Bose 901 speakers. Could you tell us what you heard at that time?

A. Well, I heard them in a relatively small room. I wouldn't want to judge the dimensions but, perhaps, oh, 10 by 12; and it was apparent that they did generate a very large acoustic image. [18-126] The sound came from all over, including from behind my head, at times. It was a very lively room, a lot of reflections in it.

Q. You heard this before you were contacted to be a possible witness in this case?

A. Oh, I can't recall the exact date, but I would guess -- it was more than seven years ago when I first heard it.

* * *

[19-68] AMAR BOSE RECALLED

Direct Examination by Mr. Perry

* * *

[19-130] Q. (By Mr. Perry) One final matter, Dr. Bose. How many pairs of Bose 901 loudspeakers has your company sold up to the present time?

A. I checked last week, and it was 234,700-and some. I don't remember the 10s digit on that.

Q. Something over 234,000 pairs? A. Correct.

THE COURT: Pairs?

THE WITNESS: Pairs, yes, your Honor.

Q. Were they all --

THE COURT: That's Bose 901s?

THE WITNESS: That's correct.

Q. Were they all of the design that had four drivers on each of the two rear panels and a single driver on the front panel? A. Yes.

THE COURT: In other words, in every way the model was identical with the model in evidence here now?

THE WITNESS: No, your Honor.

Q. But as far as the design --

[19-131] THE COURT: But it was a 901?

MR. BEIL: 901 Series 1, 2, 3, and 4, your Honor.

THE COURT: What series are you talking about? You have said since when was this --

THE WITNESS: I checked last week, your Honor.

THE COURT: From what date to what date?

THE WITNESS: Late '67 or early '68, when the 901 model first came on the market, until last week. Mr. Perry asked me how many of the model 901 were sold.

THE COURT: Without specifying the series?

MR. PERRY: That's correct, your Honor.

Q. This would include Series 1, 2, 3, and 4? A. Yes, it would.

Q. But no matter what the series number, would they all have the same basic design of four drivers on one rear panel and four drivers on another rear panel and a single driver on the front? A. Yes.

THE COURT: How many 901s first series were sold, do you know?

THE WITNESS: I don't know at this point, your Honor.

* * *

[19-135] Cross-examination by Mr. Beil

* * *

[19-153] Q. All right. If the direct paths were blocked by some means, either a person or a wall or something so it blocked the entire direct path, how would

the listener perceive the sound in that situation?

A. I don't know how to answer that because there are no words to describe all the aesthetic aspects of sound.

* * *

NOTATION OF PLAINTIFF'S
EXHIBITS 2, 7 AND 10

Ten copies of Plaintiff's Exhibit 2 (the May, 1970, issue of Consumer Reports) have been deposited with the Clerk of the Court for the use of the Justices.

Plaintiff's Exhibit 7 was a copy of the article entitled "Loudspeakers" which appears at pages 272-278 of Plaintiff's Exhibit 2.

Relevant portions of Plaintiff's Exhibit 10 (Seligson's draft report to Editorial) are set forth in footnote 15 of the liability opinion of the District Court at App. X153-X157.

PLAINTIFF'S EXHIBIT 9
(excerpt)

Personal Observation on Bose 901
upon listening for several hours

Appears to have exaggerated mid bass. Not particularly objectionable but noticeable. Piano music is unusually spread. Piano is wall to wall. Violin is also widened (Menuhin-Shanker) and appreciable moves across room. Violin not as wide as piano. Seems effect is strongest on 'centered' sounds. Try mono records.

Eureka! Mono is 'vastened' - all space noted for stereo also noted for mono. Broadening effects also noted.

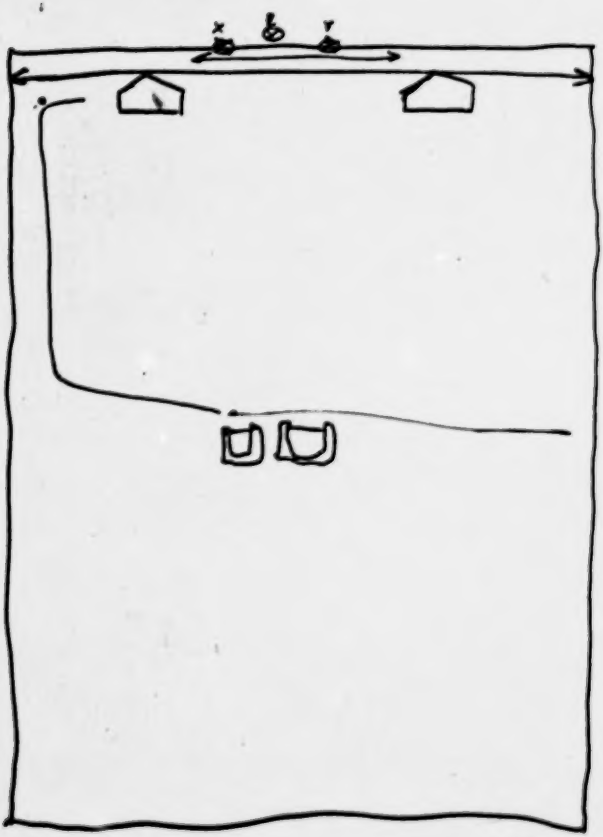
1/23/70 ALS

Lower midrange or upper bass sounds boosted, adding a "tiring", annoying quality to the sound. Sound spread out over entire wall. Stereo effects seem

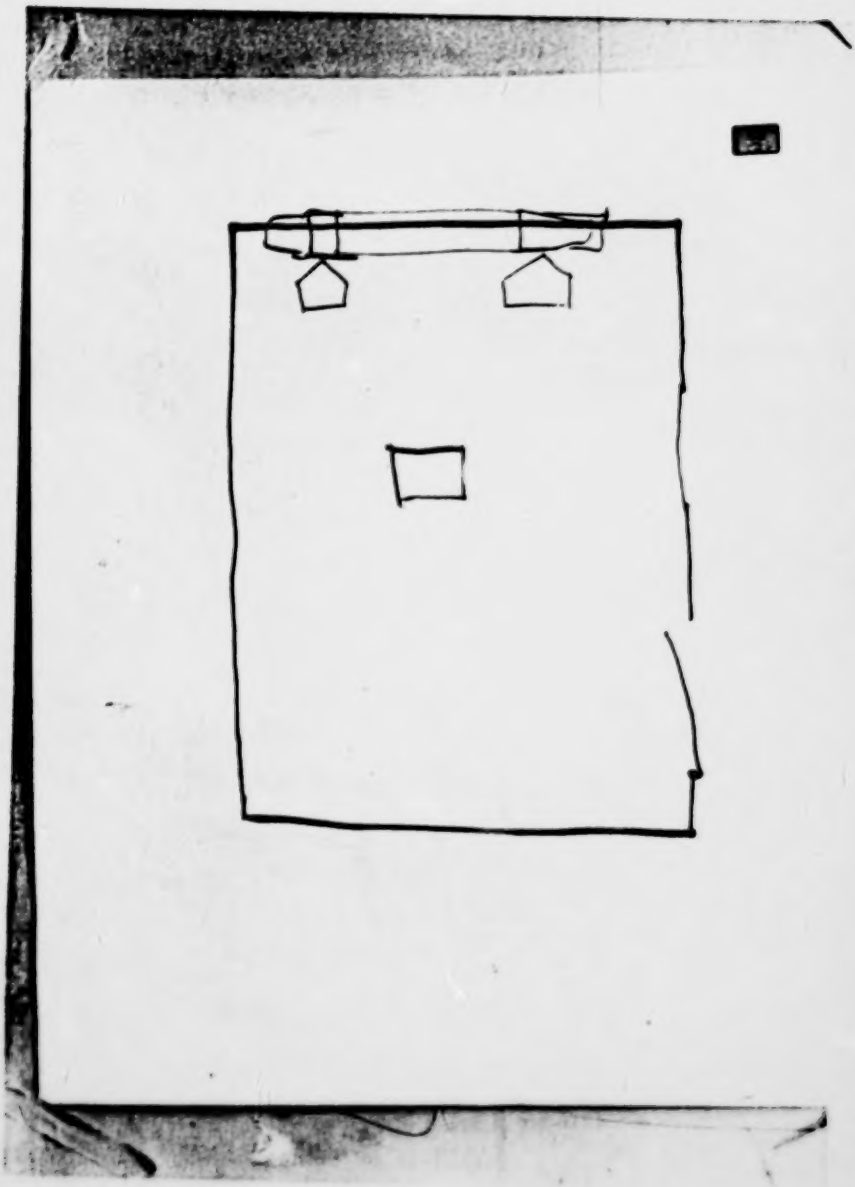
diffused; trouble in pinpointing location of soloists, especially voices. Violinist (soloist) shifted position depending on scale he was playing (different notes came from different directions. Monophonic material sounded almost like stereo. Treble range had very smooth & pleasing quality. If it weren't for upper bass emphasis, would have tone quality on par with best in project.

AL 1/23/70

THIS PAGE INTENTIONALLY LEFT BLANK



PLAINTIFF'S EXHIBIT 29



PLAINTIFF'S EXHIBIT 35

UNITED STATES DISTRICT COURT
DISTRICT OF MASSACHUSETTS

BOSE CORPORATION,
Plaintiff

v.

CONSUMERS UNION OF UNITED STATES, INC.,

CIVIL ACTION
No. 71-481-C

AMENDED FINAL JUDGMENT

February 8, 1982

CAFFREY, Ch. J.

In accordance with the Opinion of the Court filed on December 30, 1981, and after consideration of the Plaintiff's Motion to Amend Final Judgment and the Plaintiff's Motion to Reduce Taxed Costs, it is ORDERED:

1. Judgment is entered for the plaintiff on Count III of the Complaint in the sum of $115,296.00 plus interest in the sum of $85,788.11, and costs in the

sum of $9,821.53, or a total of $210,905.64.

2. Judgment is entered for the defendant on Counts I and II of the Complaint.

/s/ Andrew A. Caffrey
Andrew A. Caffrey, Ch.J.

UNITED STATES COURT OF APPEALS
FOR THE FIRST CIRCUIT

No. 82-1230.

BOSE CORPORATION,
Plaintiff, Appellee,

v.

CONSUMERS UNION OF U.S., INC.,
Defendant, Appellant.

JUDGMENT

Entered: November 2, 1982

This cause came on to be heard on appeal from the United States District Court for the District of Massachusetts, and was argued by counsel.

Upon consideration whereof, It is now here ordered, adjudged and decreed as follows: The judgment of the District Court is reversed.

By the Court:
/s/ Dana H. Gallup
Clerk

[cc: Messrs. Pollet, Perry, McHugh and Kaufman]

NOTATION OF OPINIONS BELOW

The following opinions have been omitted in printing this Joint Appendix because they appear at the following pages of the Appendix to the Petition for a Writ of Certiorari:

Opinion of the United States District Court for the District of Massachusetts, dated January 21, 1981, at App. X38.

Opinion of the United States District Court for the District of Massachusetts, dated December 30, 1981, at App. X169.

Opinion of the United States Court of Appeals for the First Circuit, dated November 2, 1982, at App. X1.

The Order of the Court of Appeals denying petitioner's petition for rehearing, dated November 23, 1982, is set forth at pages 22-23 of the Petition.

Counsel of record are:

CHARLES HIEKEN
470 Totten Pond Road
Boston, Massachusetts 02154-1981
Telephone: (617) 890-0110

Counsel for Petitioner

MICHAEL N. POLLET
Marshall Beil
Karpatkin Pollet Perlmutter & Beil
708 Third Avenue
New York, New York 10017
Telephone: (212) 557-4700

Counsel for Respondent